VOL. 193, NO. 1 JANUARY 1998

NATIONAL GEOGRAPHIC

MAKING SENSE OF THE MILLENNIUM

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Fighting in class? Mrs. Shurtz insists on it.



Recreating Pickett's Charge is just one of the innovative ways Jane Shurtz gets her fifth-grade social studies class into the spirit of American History. After the battle, her student "soldiers" write letters home describing what it's like to fight in the Civil War.

Mrs. Shurtz takes a very different approach when it comes to the Colonial period. She taxes student essentials like pencils and shoelaces so her class can understand the frustration the colonists must have felt.

The culmination of the year is The 20th Century Project. Students gather oral histories from family members and bring in heirlooms for class discussion. This project helps students feel more personally connected to this century's major events such as immigration, fighting in a World War, and living through an economic depression because they learned from those who experienced them first hand.

For showing that you can't change history but you *can* change the way it's taught, State Farm is proud to present Jane Shurtz with our Good Neighbor Award and to donate $5,000 to her school, Gray Elementary, in Springfield, Missouri. Hopefully it can help defray battlefield expenses.

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NATIONAL GEOGRAPHIC

JANUARY 1998















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Making tracks in a sea of sand, two travelers in Mauritania plow across the ageless Sahara. Photograph by George Steinmetz

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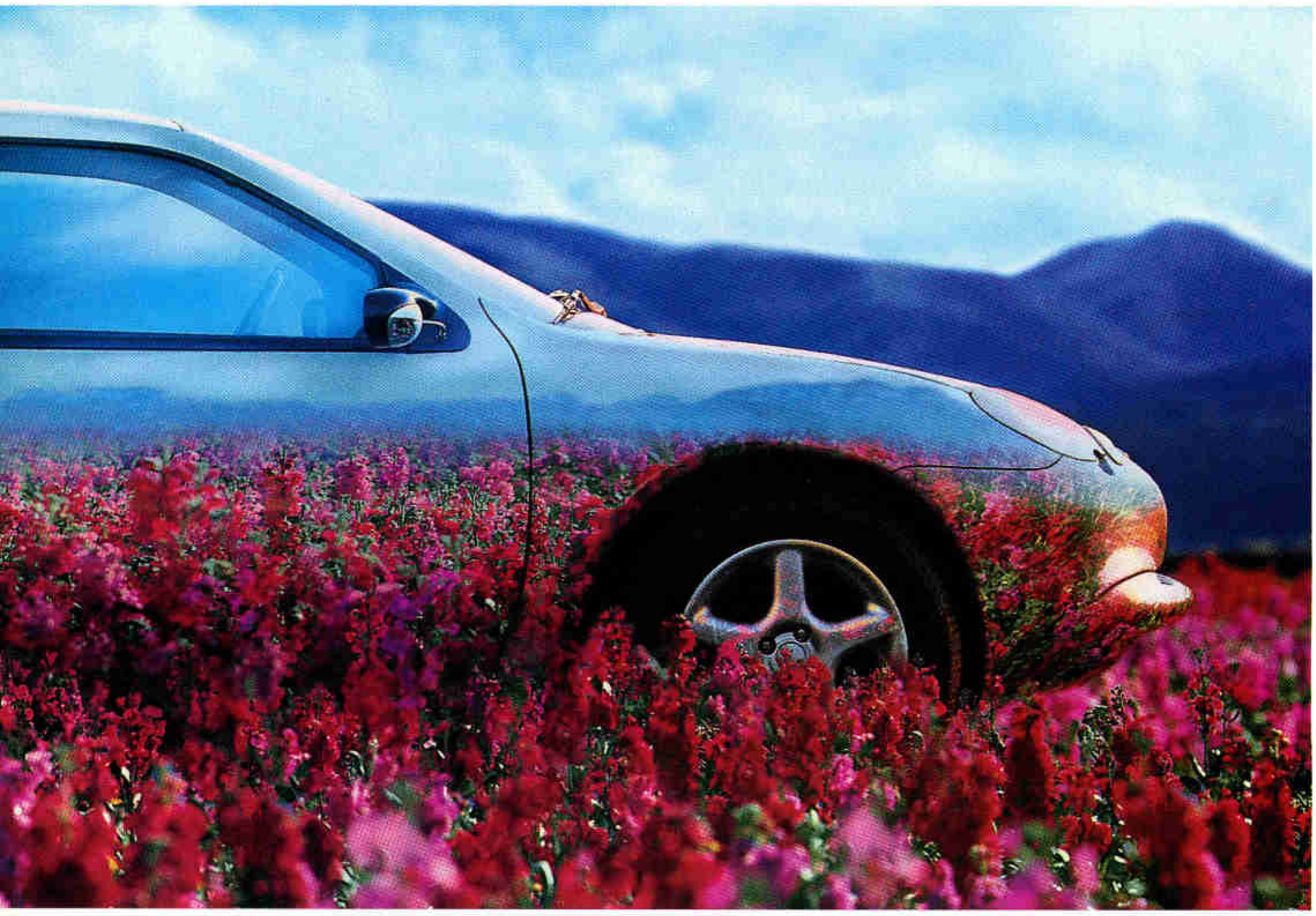
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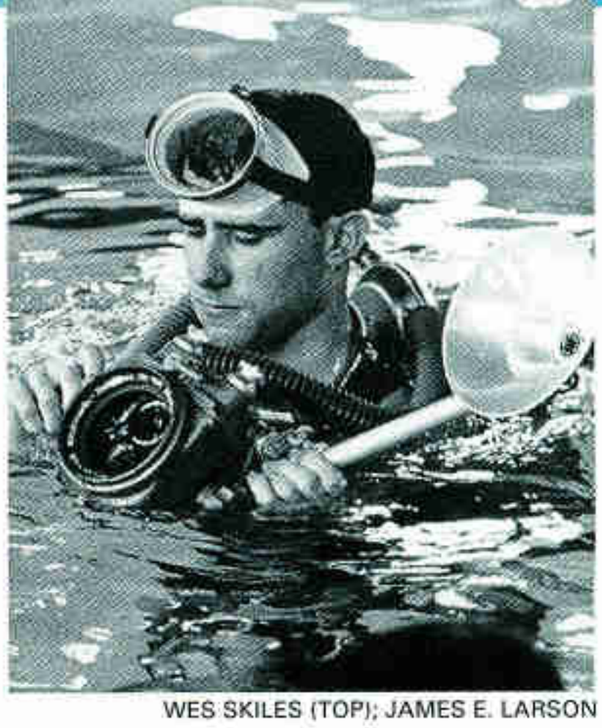
NATIONAL GEOGRAPHIC

Behind the Scenes



Immersed in His Work

He was still wet behind the ears in 1963 when he started as a GEOGRAPHIC photo intern (right), but Emory Kristof's innovations in camera and lighting technology have made big splashes ever since. He has documented the location of the *Titanic* shipwreck and searched for the Loch Ness monster; Hollywood directors consult him for advice on underwater shots. It all starts in his own Virginia backyard, where Emory (above) tests camera-carrying ROVs—remotely operated vehicles—in his swimming pool.



WES SKILES (TOP); JAMES E. LARSON



MARIA STENZEL

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TEXT BY MAGGIE ZACKOWITZ
FRITZ HOFFMANN

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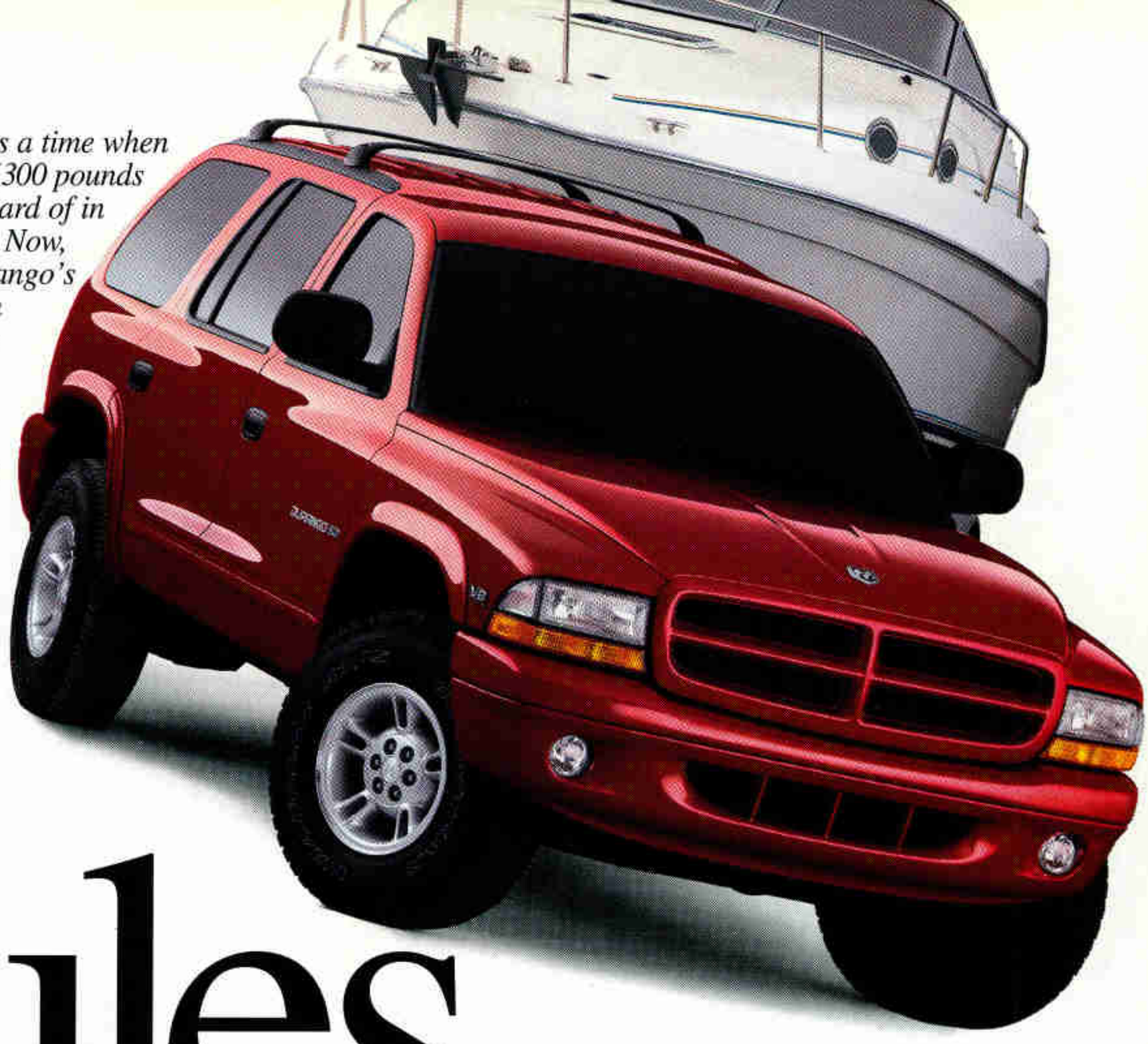


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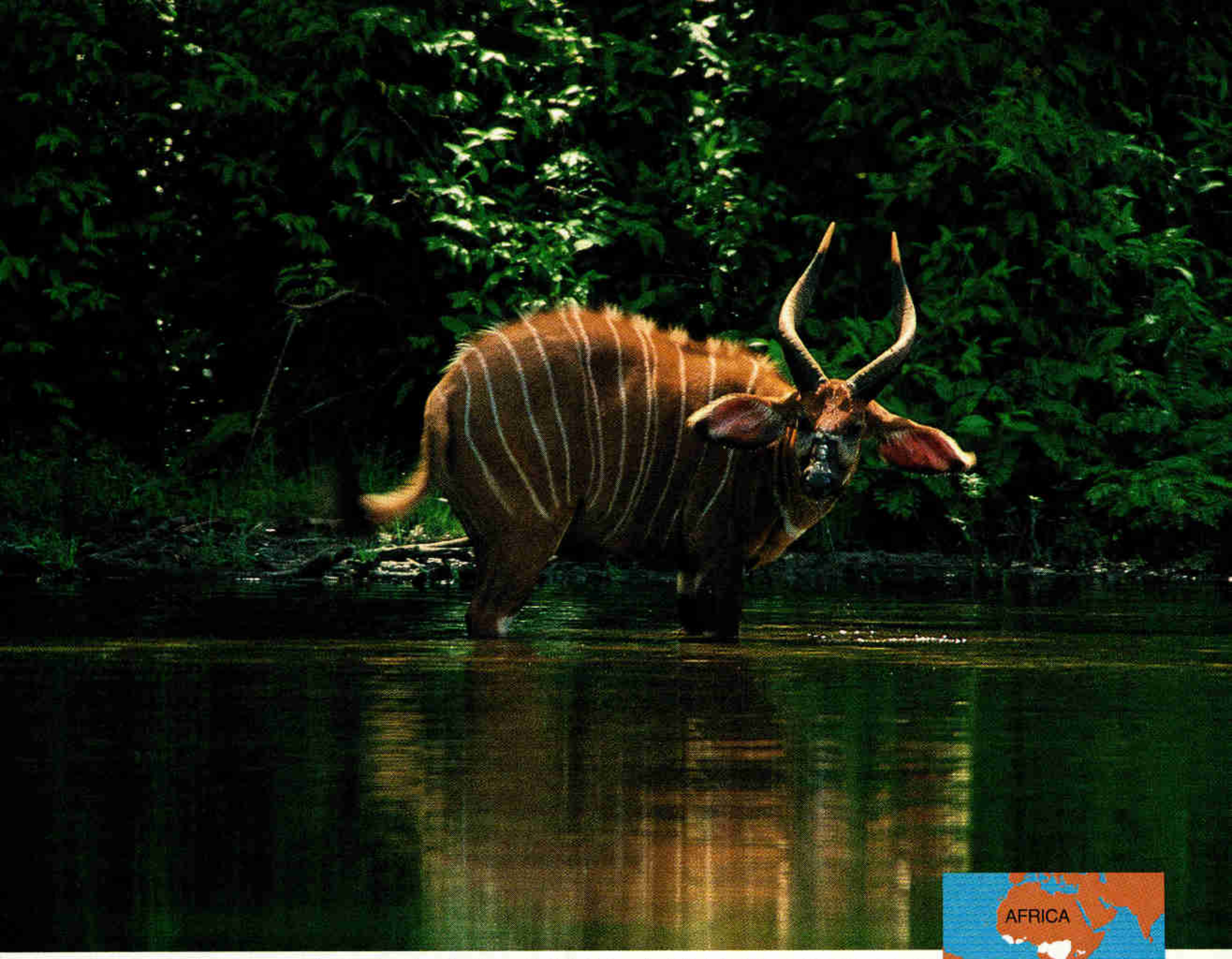
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Bongo (*Tragelaphus euryceros*) **Size:** Head and body length, 220 - 235 cm; height, 122 - 128 cm **Weight:** Average male, 300 kg; female, 240 kg **Habitat:** Ecotones in the African equatorial forest **Surviving number:** Unknown
Photographed by Richard G. Ruggiero

WILDLIFE AS CANON SEES IT

Deep in the Congo forest, a magnificent spiral-horned bongo feeds alone in a shallow pond, its brilliant chestnut-red color and white stripes illuminated by a ray of morning light. During the day, bongo range widely through dense forest in search of nutritious foliage. At night, these shy and elusive antelope emerge to browse on low regrowth along forest edges and openings. When startled, bongo run swiftly and unimpeded through tangled thickets by keeping the head low and the horns lying back on the shoulders. Overhunting and habitat fragmentation and loss have caused bongo populations to decline throughout much of their range. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

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Forum

Many readers enjoyed a dose of nostalgia in our September 1997 article on Route 66, "a road full of fond memories." One recalled traveling "in May 1942 . . . in an old Chevy with bald tires. Had at least one blowout every day." For another, life on that road was "a rite of passage after high school for several friends."

China's Three Gorges

I am just back from a trip to China and a tour of the Yangtze River. Author Arthur Zich has a real feel for the situation and the questionable nature of the proposed changes that will accompany the damming of the river. I think of the little farms, the small temples, and the archaeological sites that will be lost forever and my sympathy goes out to the displaced people. Who knows what their new homes will be.

BARBARA MADISON
Cherry Hill, New Jersey

In an age when biodiversity is being lost at an alarming rate, it is absurd to sacrifice unique species for the sake of more television sets and washing machines. China could have set an example for the world on how to modernize while protecting the environment; instead it chooses the path of greatest destruction.

RAYMOND WATT
Albuquerque, New Mexico

Opponents of the Three Gorges Dam claim that the reservoir would lead, for example, to the destruction of the river dolphin habitat, thus endangering the species. But this unbridled habitat has flooded many times and killed hundreds of thousands of humans. The ideal solution would be to protect all life impacted by the river. But even if only one human is saved from the floods, wouldn't the Three Gorges project be considered a success?

DOUGLAS FORAN
Aloha, Oregon

The power the dam will generate will surely increase the quality of life for millions of Chinese, the vast majority of whom, I am sure, live without running water not to mention electricity. I would expect that you would applaud the Chinese for choosing non-emissive hydroelectric power, rather than burning the usual dirty coal and oil, which have given many communist nations their famous gray scenery. A hydroelectric dam is a good compromise between many different political and environmental concerns.

MOSES A. FRIDMAN
Cleveland, Ohio

I recommend the novel *A Single Pebble,* by John Hersey, as a glimpse into the traditional way of life along the ancient river before it is forever changed.

CHRISTINA POTIS
Olympia, Washington

How could a government initiate such a project without undertaking a full social and environmental impact assessment? South Africa is also in the process of large dam construction, the eight-billion-dollar Lesotho Highlands Water Project, to provide water for South Africa and power to Lesotho. Five dams will be constructed, and an environmental impact assessment has been initiated. Approximately 32,000 people will lose land or be relocated, and about 11,000 hectares [27,000 acres] of grazing or arable land will be lost. A recent development is a new World Commission on Dams, headed by South African Minister of Water Affairs Kader Asmal, to conduct an independent review of the cost and benefits of large dam projects around the world. It is to be hoped that Professor Asmal's experience with the Lesotho project will force future projects to take into account their impact and integrate such assessments into the planning process.

STEWART GREEN
Scottsville, South Africa

Route 66

The article helps us Europeans learn about America and understand your country. It was surprising to see the car sticker of my home country, Hungary, in the window of the visitor center in Hackberry. I wonder how it got there.

BEA KOVACSOVICS
Linköping, Sweden

How did Vincent Musi manage to photograph the sunset or sunrise and a vehicle suspended in air over distant mountains (pages 48-9)? We've been puzzling over this photo and cannot arrive at a logical conclusion. We have seen strange things on sections of Route 66 but nothing like this.

RICHARD L. VANNICE
Albany, Oregon

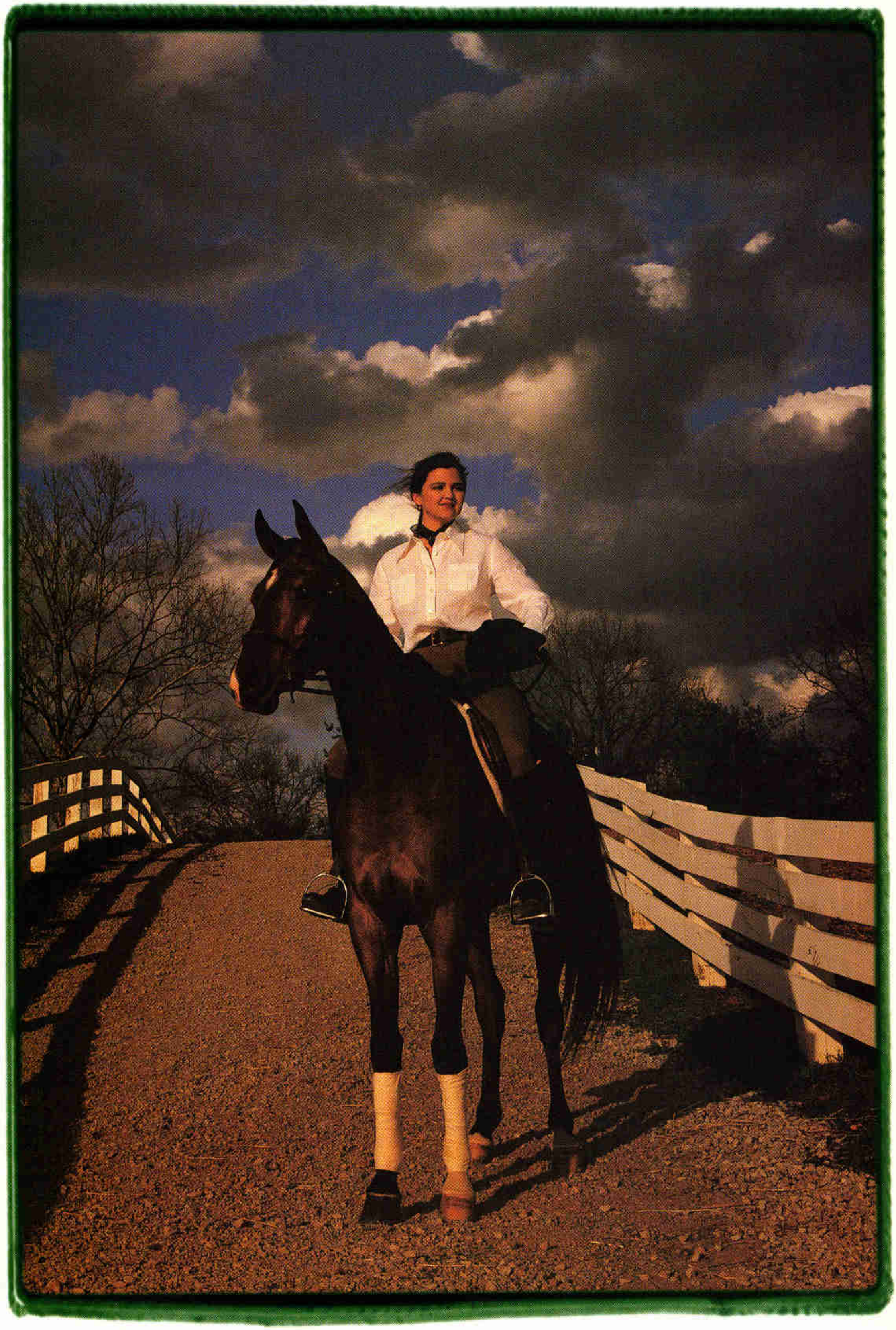
From inside his car Musi photographed the mountains ahead. His rearview mirror—its black frame blurred —reflects a following car and the sunset.

Being born and raised in southern California, I never had a conception of Route 66 as a near-mythical great western road. For my sisters and me, bored senseless in the back of the family car, it was always the endless road to visit relatives way back east—in Albuquerque.

CHIP PALMER
Rohnert Park, California

Nunavut

Having traveled "north of sixty" for the past seven years, I read with great interest "A Dream Called Nunavut." The photographs truly captured the essence of the land. While it is true that large changes are headed north, surely the future is



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brighter than that painted by author Michael Parfit. Further, featuring a polar bear hunt will only increase the demand for so-called sport.

RUSSELL S. TAICHMAN
Ann Arbor, Michigan

As a retired military officer who has experienced combat, I have rarely had anything touch me to the core of my being like the photograph of the killing of the beautiful polar bear (pages 82-4). I hope it may stir some like-minded soul to some action that would preclude future killings such as these.

REV. CANON BEVERLY L. BARGE
Lake Mary, Florida

I returned from the Canadian Arctic recently and was delighted to see your article. On a voyage from Greenland to Churchill, including stops at Resolution Island, Kimmirut, and Walrus Island, I was introduced to the natural beauty of the region and to the Inuit people. Few tour groups visit Kimmirut, so the locals rolled out the red carpet. We were provided with demonstrations of stone carving, preparing sealskin for clothing, and traditional games and even given Inuktitut language lessons. It was refreshing to see that children and adults alike took great pride in their history and traditions. Thanks to you, perhaps others will be inspired to make the journey north to experience this firsthand.

TERA KILLIP
San Francisco, California

I was very impressed with how you presented the particular difficulties the Inuit will have in developing a stable economy. Though these are issues that any newly formed government has to decide, the complexities the Inuit face—their history with the destabilizing power of money, their renewed sense of identity, and their symbiotic relationship with Arctic wildlife—make their situation unique. They are a courageous people, just the type I like to read about in your pages.

JEROME STUEART
Wichita, Kansas

Beirut Rising

I was disappointed by the limited discussion of the real issues underlying the rise of the new capital. The new city is a demonstration of Lebanese people returning with the hope of building a new life after years of war. But in the midst of development, Beirut is losing its heritage and its meaning. The capital is becoming a haven for foreign investment with much of the interest focused on the economy and little on the social and environmental sectors. As a Lebanese returning to Beirut, I am sad to see the country in such a mess. The rebuilding is very superficial; underneath lies a broken infrastructure. Investors see big profits in development, while environmentalists and aid workers foresee the detrimental effects of overconstruction and urbanization on poverty and the environment.

TANIA MANSOUR
Beirut, Lebanon

Siren Song of Everest

Quit beating us to death with articles on the suffering of Everest climbers. They chose to do this, knew what could happen, and should accept the risks. Climbing Everest is no different from playing Russian roulette.

M. ALLEN WRIGHT
Harrison, Arkansas

Looking at the slope littered with empty oxygen canisters (page 131) made this nonenvironmentalist's heart sad. Doesn't the government of Nepal have the rule "pack it in; pack it out"? Everyone, including me, can learn to be better stewards of the Earth by following a few simple rules.

SANDRA SHUPE
Tucson, Arizona

An estimated 50 tons of trash has been discarded by climbers over the years. In 1994 mountaineers Brent Bishop and Chris Naumann initiated a plan to give bonuses to Sherpas who carried down trash. Some 7.5 tons has been removed. The accumulation of canisters and other refuse has now ceased, because Nepal rigorously enforces a new pack-it-out rule.

I recently returned from an overland trip from Lhasa in Tibet to Kathmandu in Nepal with a two-day stay at a base camp in Tibet, a place completely unspoiled. There is no trash, no tents. In fact, in November 1996 we were the only people there. It was a sight of rugged beauty and magnificence.

GREG R. BLASKO
San Antonio, Texas

Journalist Bruce Barcott is quoted in the article (page 130) as saying, "Unlike any other sport, mountaineering demands that its players die." As an amateur race driver, I can forcefully attest that mountaineering is not the only sport that strikes down its own children. The dedication plaque for the Apple Memorial Chapel at our home track, Summit Point Raceway in West Virginia, reads, "This chapel is dedicated to the glory of God and to the memory of those who have lost their lives here in pursuit of the sport they loved."

J. R. BACHTLER
Salisbury, Maryland

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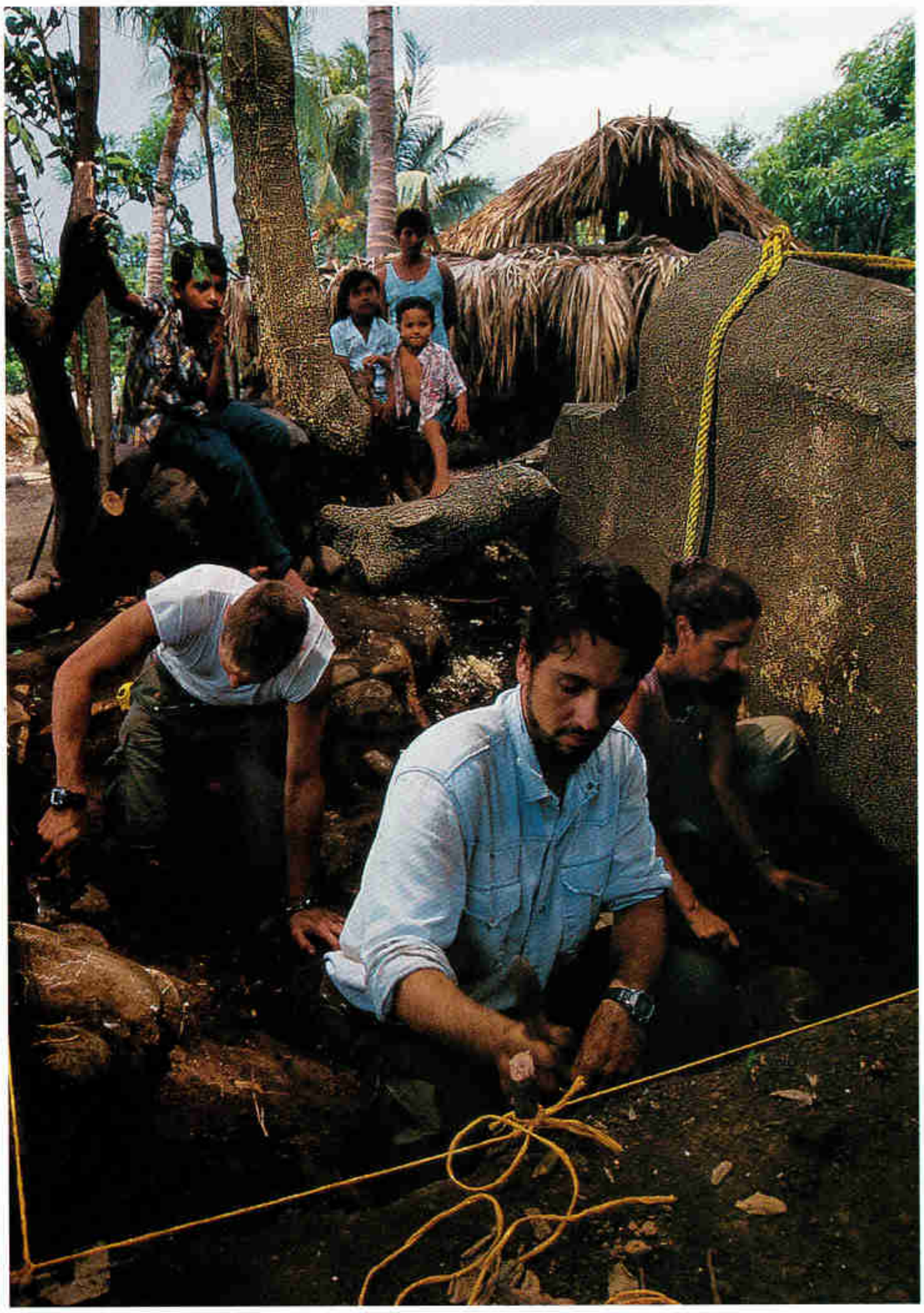
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BOTH BY KEITH DANNEMILLER

■ A major site at Ujuxte (above), occupied between 400 B.C. and A.D. 250 by people who produced pottery in the Maya style. The site featured a central plaza lined with large stelae and altars backed by huge mounds. The plaza's east-west axis was oriented to the rising of the sun on the mornings of the spring and fall equinoxes.

"This is one of the southernmost sites in the Maya world with a religious-astronomical complex of stelae and altars," Estrada Belli says.

■ La Nueva, the most recently discovered site, where some 5,000 Maya lived from A.D. 250 to 900. The stela Estrada Belli is raising bears the carved image of a ruler wearing a large headdress of quetzal feathers and holding a sword. Most likely this person ruled the site around 800, at the height of its power.

"Before we started our work, we were unsure whether the Santa Rosa region was even within the Maya area," says Estrada Belli. "These monuments reveal that it was."

■ NGS RESEARCH GRANT

Major Maya Finds on Guatemala's Coast

Under the watchful eyes of villagers, archaeologist Francisco Estrada Belli (above) prepares to lift a Maya stela at La Nueva on Guatemala's Pacific coast, where it lay hidden for approximately 1,100 years.

Rarely visited by archaeologists and long considered an archaeological backwater, the surrounding Santa Rosa region has produced surprise after surprise ever since Estrada Belli, a Boston University graduate student, began to systematically map and explore it in 1995. Among the discoveries:

■ The remains of a seaside community dating from 1300 B.C. at Chiquiuitán. It yielded large globular storage jars—and the remains of the residents' food, including shellfish, crabs, deer, small rodents, turtles, and birds.

Things we've noticed about Americans:

Going places is a national obsession.

Been there, 1969. ← CASE IN POINT: → The reliable Chevy Malibu.



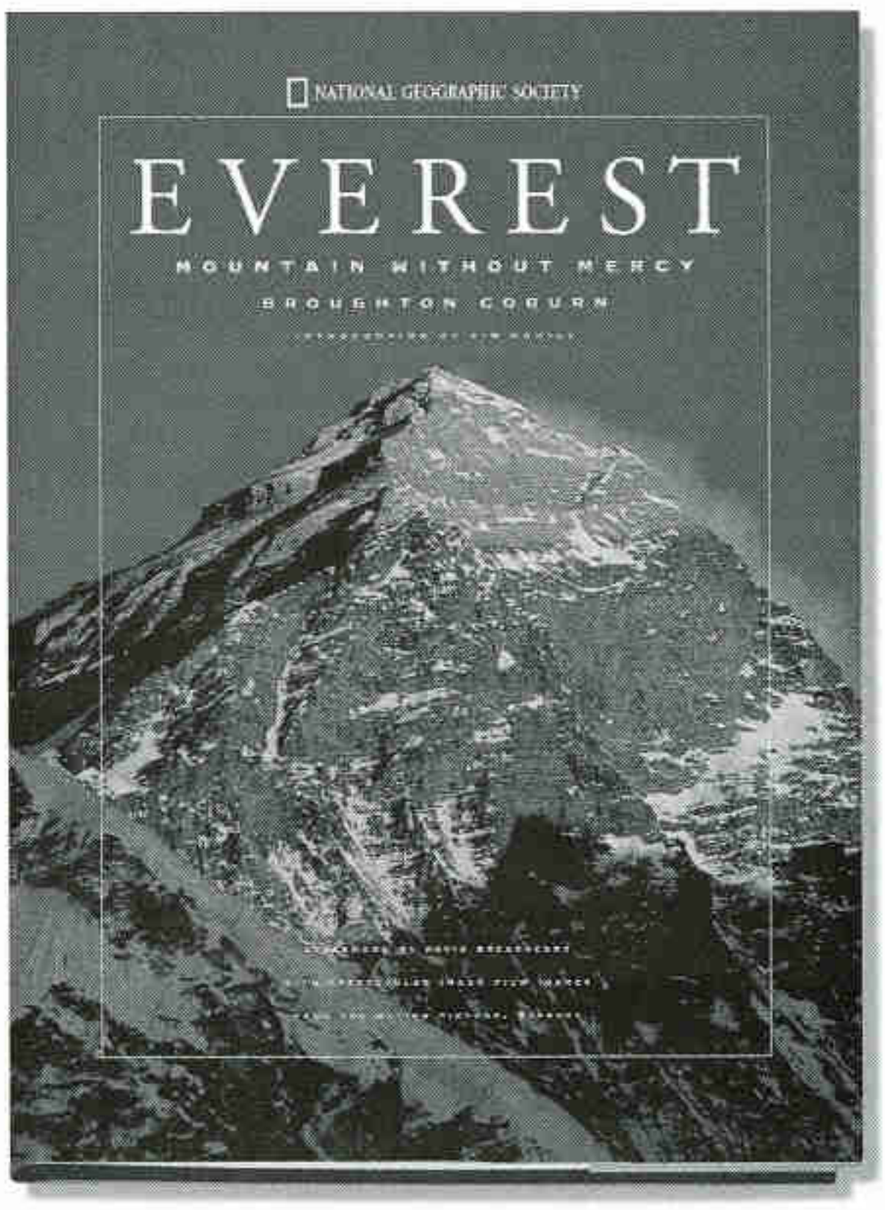
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Rowing to Iona in the Wake of an Irish Saint



ANNE WILSON

Powered by faith and the strong arms of ten men and four women, an oversize reproduction of a traditional Irish curragh sets off on a 135-mile voyage from Londonderry, Northern Ireland, to the Scottish island of Iona. The six-day journey, at times aided by wind in the boat's sails, marked the 1,400th anniversary of the death of St. Colmcille, also known as St. Columba. The Irish monk established a famed monastery on the isle in 563. Iona's missionaries later helped convert Scotland to Christianity.

The 38-foot-long vessel, christened *Colmcille* and thought to be the largest curragh ever built, was made of oak, pine, and teak covered with tarred canvas.

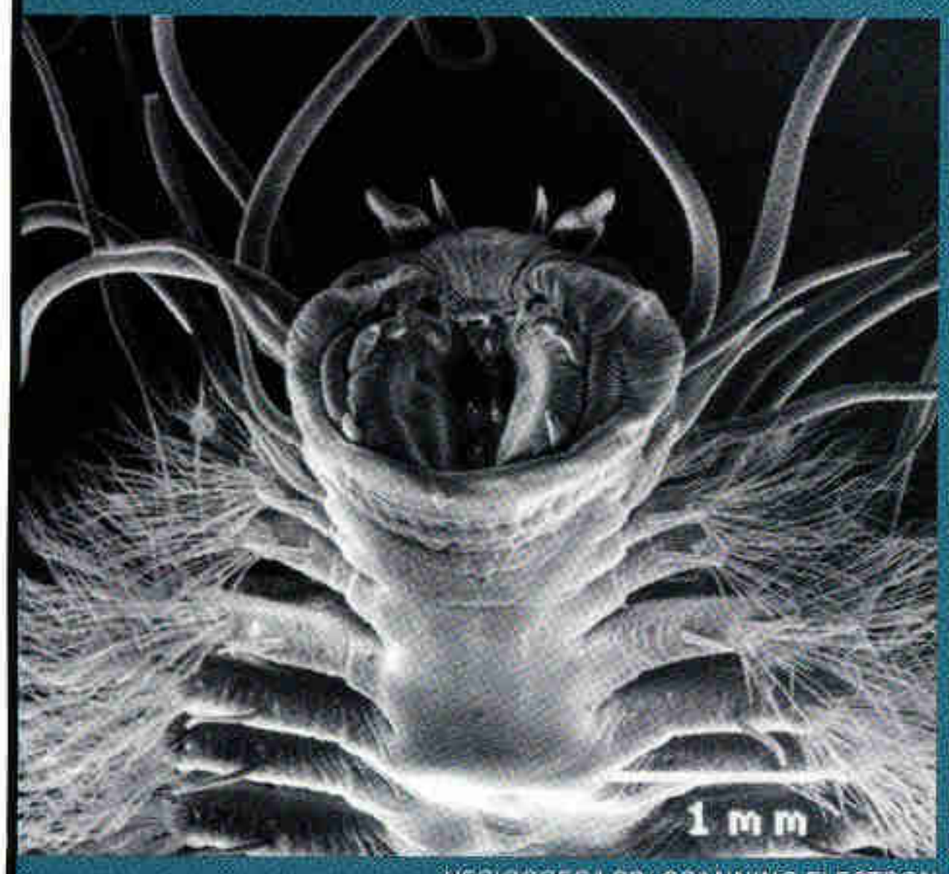
"Saint Colmcille undoubtedly used a curragh with leather stretched over the frame," says Jim Allen, a crew member and chairman of the Causeway Coast Maritime Heritage Group, which organized the journey.



DONALD NELSON

The project joined people from Northern Ireland's Protestant and Catholic communities. They stopped at Irish and Scottish towns to talk about their adventure. "That was the object of the whole exercise, to communicate the essence of the voyage, its message of sharing and reconciliation, to others," Allen says. Heavy seas and storms also forced stops; at the end "there was a lot of collapsing in each other's arms," he says.

Marine Worms Thrive on a Methane Mound Deep in the Gulf



HESIOCOECA SP.; SCANNING ELECTRON MICROGRAPH BY ROSEMARY WALSH

Gliding along in a submersible 1,800 feet down in the Gulf of Mexico, Pennsylvania State University biologist Charles Fisher saw what looked like a multicolored mushroom, six feet in diameter, jutting up from the seafloor. At closer range he realized it was a methane hydrate—an icelike mixture of water and methane gas that had seeped from the bottom—covered with a new species of inch-long marine worms. Their profusion startled Fisher, a pioneer in the study of life without light in the Gulf (GEOGRAPHIC, October 1996). The creatures somehow feed off bacteria that convert the hydrate into nutrients. In his lab Fisher studied the worms to discover their secrets. "This worm," he said, "has the capability to live in a unique, stressful place."

TEXT BY BORIS WEINTRAUB

Legal Notice

IF YOU OWN A HOME THAT WAS BUILT OR REMODELED IN THE LAST 10 YEARS, PLEASE READ THIS LEGAL NOTICE.

If Louisiana-Pacific Oriented Strand Board Sheathing has been installed in your home or building, you may be a member of a settlement class and entitled to an additional 20 year Warranty.

The Settlement and Warranty.

The Settlement arises from a pending class action lawsuit in the United States District Court in San Francisco, California, relating to Louisiana-Pacific Oriented Strand Board Sheathing. By the Settlement, Louisiana-Pacific has agreed:

- **to warrant the performance of its OSB sheathing products for the 20-year term of the Settlement; and**
- **to pay the full cost of replacing any of its OSB sheathing product that sustains damage due to a manufacturing defect during the period of the 20-year warranty.**

The Settlement is subject to final approval by the Court at a hearing that has been scheduled for February 6, 1998. Warning: Persons whose homes contain L-P OSB but have not experienced any problems with the OSB should be aware that they are bound by the terms of the Settlement Agreement. It is possible that some present Class Members would recover substantial punitive damage awards if they opt-out of or object to the Settlement and seek an independent remedy in court. Class Members are encouraged to state their views at the Fairness Hearing scheduled for February 6, 1998, at 2:00 p.m.

How to Object or Exclude Yourself.

If you want to object to this Settlement, write to the United States Courthouse, 450 Golden Gate Avenue, San Francisco, CA. Your written request must be mailed and postmarked no later than January 20, 1998. To exclude yourself from the terms of the Settlement, send your request to the address below on or before January 20, 1998.

If you have this logo on sheathing in your home, you could be eligible for an additional Warranty.

What Is OSB.

Oriented Strand Board ("OSB") is a wood panel product manufactured from strands of wood that are "oriented" in one direction and then glued together under very high temperature and pressure. OSB panels are manufactured in different thicknesses for use as roof, wall and floor sheathing in residential and commercial construction, frequently as a substitute for plywood.

How to Obtain the Warranty.

If you do not exclude yourself from this Settlement, you will automatically receive the additional Warranty. If you experience any problem with your L-P OSB sheathing, you need only file a claim before October 22, 2017. For more information, or for a complete copy of the Settlement Notice, and how to exclude yourself from it, call the number below or send a request to the address below.

This Settlement and Warranty concerns OSB Sheathing products only; it does NOT concern external OSB siding products used on homes and buildings. The complaints in the consolidated actions that are the subject of the proposed Settlement allege violations of federal statutes (Lanham Act; RICO statute), breach of warranty, and violations of state consumer protection statutes.

Louisiana-Pacific denies the allegations of the complaints; and denies in particular that any of its OSB sheathing is defective or has failed or will fail when properly handled and installed; and contends that the performance of its OSB sheathing has been as good as any in the industry.

For More Information,

CALL 1-800-577-4836

or write: L-P OSB Trade Practices Litigation; PO Box 1537; Faribault, Minnesota 55021-1537

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NATIONAL GEOGRAPHIC

From the Editor

A PERIOD OF ONE THOUSAND YEARS carries no inherent significance of its own. After all, it is only because we come equipped with ten fingers and our ancestors used them to create base-ten math that a thousand equals a thousand as we know it. If fingers plus toes had been used as the basis for our math system, a "millennium" would have 8,000 years in it.

There's even disagreement as to just when the next millennium will begin. Because there was no year zero—our calendar goes right from 1 B.C. to A.D. 1—many people insist we ought to delay our champagne toasts until the arrival of January 1, 2001. But most of us will stay up on December 31, 1999, watch the odometer spin to all those zeroes, and declare the new millennium born. And some calendarists (yes, there is such an academic animal) have pushed the whole of B.C. back one year, inserted the year zero in the gap, and declared the conflict solved.

Nevertheless, a thousand years, or two thousand years, is simply a cold mathematical entity—until we humans begin draping it with banners of hope and wrapping it in shrouds of remembrance.

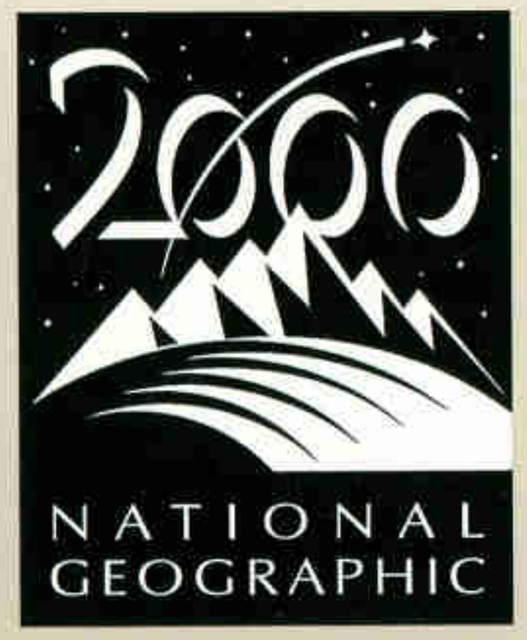
In this spirit of elasticized millennia, the NATIONAL GEOGRAPHIC magazine this month begins its observance of the great calendar turn with an introductory article addressing the large topics we will be examining in future issues. In February our in-depth coverage gets under way with four articles featuring the spirit of exploration. The millennial series will continue through 1999.

Some might argue that we're jumping the gun a bit—like stores that put out Christmas merchandise at Halloween. But our goal is to introduce the key issues the world community will face in the coming years, millennium or no. When those goose eggs click into place two years hence, it would help to have an action plan in place.

Bill Allen

Making MILLE

By **Joel L. Swerdlow** ASSISTANT EDITOR
Photographs by **George Steinmetz**



EARLY ON A SUNDAY MORNING I stand in Times Square talking with members of the 1,000-strong Times Square All Star Marching Band. Police are setting up barriers for crowd control, but at this early hour the sidewalks are empty. ■ The Times Square Business Improvement District has gathered the band—whose members come from New York, New Jersey, and Connecticut—to mark this day, April 6, 1997, one thousand days before the first day of the year 2000. At noon the band will perform in front of the Times Square electronic ball. ■ This concert is just one more manifestation of millennium mania, which already includes millennium websites, a *Millennium* TV series, a "Millenia" car, and a "Millennia" perfume. Kiribati, a nation of islands in the South Pacific, has moved the International Date Line and will claim the first dawn of the year 2000. Walt Disney World Resorts and Seattle's Space Needle are sold out for New Year's Eve 1999. ■ But there's more to the dawn of the third millennium than celebration. Verses in Revelation such as "And when the thousand years are expired, Satan shall be loosed out of his prison" have inspired in some a belief in a coming apocalypse. ■ Much of the fuss over the millennium is a sign of our times. Amid competition among newspapers, magazines, radio, and TV for attention, every angle is pursued, breeding public cynicism, even exhaustion, before the year 2000 arrives. ■ This new millennium, however, is special for another reason.

A frequent contributor, Los Angeles-based GEORGE STEINMETZ has photographed subjects ranging from Irian Jaya, Indonesia, to oil exploration and robots.

Sense of the MILLENNIUM

For the first time in history virtually everyone on earth knows it's coming. Though in the sixth century Dionysius Exiguus, a monk living in Rome, devised our system of counting from the year Christ was born, few Europeans had calendars or knew that the year 1000 had arrived. Worldwide use of the Christian calendar didn't begin until the late 1800s, a result of imperialism and trade. ■ Other cultures have kept their own calendars. Jews count from 3760 B.C., identified as the moment of creation; some Hindus, from 3102 B.C., the beginning of the Kali Yuga time cycle; and Muslims, from Muhammad's flight to Medina in A.D. 622. But with the exception of Islamic apocalyptic beliefs, none of them ever treated the passage of a thousand years as anything out of the ordinary. ■ For many people today the millennium is far from ordinary, as Chrystal Lacey pointed out in Times Square. Chrystal is a 15-year-old flutist from New Jersey, and a member of the class of 2000. "People will look back on us. We must do our best," she said. "The hard part will be knowing how." ■ When people look back on us, what will they see? Over the next two years NATIONAL GEOGRAPHIC will take a snapshot of the world as it approaches the year 2000. In 20 stories we'll cover six themes of global importance—why we explore; how our physical world is changing; the pressures of population growth; why biodiversity matters; our cultural landscape; and new challenges facing science. ■ These stories are about the same thing—our relationship to nature and to one another. Some hit close to home, others probe faraway places. Fundamental to all is our need to know more, to explore new worlds.

Before the year 2000, NATIONAL GEOGRAPHIC plans to spotlight six subjects that will shape human destiny in the next thousand years:

Exploration

Physical World

Population

Biodiversity

Human Culture

Science

To make more sense of the millennium, visit www.nationalgeographic.com.

Exploration

Today it's easy to believe that no unexplored worlds remain—that we've seen everything, in person, on television, or in photographs. But a new era of exploration is under way. This exploration, which uses everything from space probes to hairlike fibers to go where the human body can't, may help answer one of humanity's most enduring questions: What is life's place in the universe?

■ **CIRCA A.D. 1000: Few educated Europeans believe the world is flat, but they seldom venture out into the open ocean. The Norse are unusual in this regard; Leif Eriksson lands in what is now northeast Canada. Polynesians have already colonized Fiji and the Cook Islands and begin to settle in New Zealand. The Chinese have ships big enough to sail around the world, but do not do so. They also have a magnetic needle and use it for navigation in 1119.**



MAURITANIA, WEST AFRICA

Images taken by the Galileo space probe last winter show ice sheets covering what may be a liquid ocean on Europa, one of Jupiter's 16 moons. This ocean could be larger than all those on earth combined. On earth, where there's water, there's life. Could the same be true on Europa?

The more I learn about Europa—it might have under-ice volcanic vents that provide life-inducing heat—the more excited I get. But exploring Europa with probes and other complex machines could cost hundreds of millions of dollars per mission. Will the public support such an investment when so many human needs on earth go unmet?

Scientists hope to launch a probe in 2004 to examine Europa's ice. If they can secure the funds for subsequent missions, a vehicle called a Cryobot/Hydrobot will arrive on Europa's surface some ten years later.

Possibly using knowledge gained from the New Millennium Mars microprobe, which is scheduled to penetrate the surface of Mars in 1999, the six-foot-long, pencil-shaped Cryobot would land point down on Europa's surface and heat itself. It would then sink through the ice until it reached the subsurface ocean. Then it would launch the Hydrobot, which would cruise Europa's unnamed waters in search of carbon, nitrogen, and other elements scientists believe to be essential for life to exist. Much of this technology resembles what scientists have tested beneath Antarctica's ice. A prototype may conduct test probes into Lake Vostok, the 124-mile-long, 30-mile-wide lake under two miles of ice in Antarctica.

To reach Europa could take from two to six years, a wait longer than many earth-bound explorers have endured. Christopher Columbus, for example, hit land in the New World 70 days after leaving Spain.

Life on Europa might seem as far-fetched as the existence of the huge continents between Europe and Asia that Columbus stumbled upon, were it not for the discovery on earth that microbes called extremophiles live in conditions such as ice, highly salty environments in the Dead Sea, and boiling water at the bottom of the ocean.

In 1967 Thomas Brock, then a microbiologist at Indiana University, tied strings to microscope slides, attached the other ends to logs or rocks, and dropped them into hot springs in Yellowstone National Park. Although the water temperature was 199°F, above the known temperature limit for bacteria, dense colonies of bacteria soon covered the slides. Brock had discovered the first hyperthermophile, a kind of extremophile that withstands very high temperatures.

In the new era of exploration we will continue to challenge accepted truths, which will lead to discoveries we can't even imagine. Maybe someday we'll even find a form of life that doesn't need carbon, nitrogen, and water —something science now says is not possible.

Physical World

■ **CIRCA A.D. 1000: Mesoamericans track the movements of the sun, moon, planets, and stars. Chinese seismographs measure earthquakes. Ibn al-Haytham, a Muslim mathematician and astronomer, studies atmospheric refraction, and by the 1100s a fellow Muslim, geographer Abu Abdallah Muhammad al-Idrisi, divides the world into seven climatic zones. Climate changes have long since turned vast savannas and grasslands bordering Africa's Sahara into desert.**

Discoveries here on earth are changing much of our understanding of the physical world. Until recently no one thought that human actions could affect the world on a global scale. Now some scientists believe that for the first time in recorded history such changes are occurring.



AGUA AZUL, MEXICO

In 1974 scientists first observed that chlorofluorocarbons (CFCs)—synthetic compounds invented about 70 years ago and used today in refrigeration and the electronics industry—threaten the ozone layer of earth's atmosphere. Ozone depletion also occurs when CFCs interact with aerosols from volcanic eruptions, although volcanoes alone do not cause ozone depletion.

For roughly a billion years the ozone layer has shielded earth from the sun's ultraviolet rays. But CFCs and other man-made compounds have punched a hole twice the size of Europe over Antarctica. The subsequent increase in ultraviolet radiation reduces some crop yields, has been linked to a higher incidence of skin cancers and cataracts in humans, and may suppress our immune systems.

As of 1997 more than 160 countries had signed the Montreal Protocol, committing to cut use of CFCs in half by 2000. Some countries, including the U.S., have promised more aggressive reductions. Concentrations of ozone-depleting chemicals have started to decrease, in part because cars with air conditioners are spewing less of the CFC dichlorodifluoromethane. Fortunately for people who like to stay cool, engineers have devised an air-conditioning system that relies on a non-ozone-destroying compound. All new vehicles sold in the U.S. after 1994 must use this new system.

As the supply of dichlorodifluoromethane dwindles, the price of comfort has gone up for people like me who own older vehicles. The installation of the ozone-destroying Freon that had cost me $30 when my car was new now costs $130.

Mike Cunningham, who owns an auto shop in Bethesda, Maryland, showed me how my car air conditioner's condenser connects to the accumulator.

"Your car holds 2.12 pounds of Freon, and you've got about one and a half pounds in here," Mike said.

"What's happened to the rest?" I asked.

"Into the atmosphere," Mike replied. "We'll inject dye, and see if we can find the leak."

"You mean I've been destroying the ozone layer?" I said, not hiding concern. One chlorine atom from a CFC can destroy more than 100,000 ozone molecules. The leak in my air-conditioning will destroy millions, if not billions, of ozone molecules.

"Don't feel bad," Mike said. "About half of all car ACs leak, and we never find the source." He injected the dye but with no success.

That ozone depletion is reversible provides some reassurance. With curtailed use of chlorofluorocarbons, experts say, the ozone layer will likely return to its original state around the year 2050.

But my automobile sends a lot more into the air than CFCs. Burning gasoline also releases carbon dioxide, which traps heat in the atmosphere. Since the industrial revolution such greenhouse gases, including methane and nitrous oxide, have been raising earth's global

temperature, half a degree this century alone.

Some experts argue that global warming is part of the planet's natural rhythm, unrelated to human activity. Why curtail the use of fossil fuels, they ask, when the causes of global warming are not clearly understood?

Whatever its causes, global warming may have contributed to more extreme weather, such as droughts and severe floods. Another indicator of climate change may be the gradual shrinkage of ice shelves in Antarctica. Several ice shelves have retreated and collapsed in the past 50 years.

Global warming may also be raising sea levels through the thermal expansion of water and the melting of glaciers around the world. With a three-foot rise in sea level (a possibility by the end of the next century), many coastal populations would be at risk. Nearly one-fifth of Bangladesh would disappear.

The problem of global warming may be harder to solve than ozone depletion. Output of greenhouse gases would increase significantly if the world's population, now about six billion, reaches—as experts suggest—more than nine billion by 2050.

Population

Although mass starvation as a result of global overcrowding has been incorrectly predicted for hundreds of years, population growth may be the most pressing issue we face as we enter the new millennium. Even though the rate of world population increase has started to decline, and despite dangers from deadly viruses such as the one that causes AIDS, our numbers have more than doubled since 1945. Scientific advances, such as an antimalaria vaccine, could trigger new population surges.

■ CIRCA A.D. 1000: Earth's population is 250 million, unchanged for a thousand years. China is home to one-fourth of these people. Cordova, Spain—the world's largest city—has 450,000 inhabitants. World population will grow by an average of one-tenth of one percent a year until modern medicine and improved public works emerge in the 1700s. Half of all children die before age five. People who survive childhood often live into their 60s and 70s.



MAURITANIA, WEST AFRICA

In 1798 when Thomas Malthus, a British economist and demographer, wrote that famine, disease, and war keep population at supportable levels, there were 800 million people in the world. Earth now supports seven times that many, thanks to improvements in farming and public health. Vaccination, for example, has eradicated smallpox, which would otherwise kill millions of people each year.

To get a feel for the effects of population growth, I visited Carlsbad, California, a city of 70,000 in northern San Diego County. Made up of empty canyons and arid hills until the 1960s, the county is expected to be home to more than five million people by the middle of the next century.

Carlsbad, called "the jewel" by its residents, has wide, tree-lined streets, three lagoons, and hills covered with farms growing tomatoes, flowers, and strawberries. Along El Camino Real, the city's major north-south roadway, I saw a group of men sitting on rocks. When I pulled over, they approached my car, smiling. They were Mexicans, looking for work. I was getting my first lesson in population growth: It generates migration.

"These migrant workers drift back and forth between the United States and Mexico," said Roberto Martinez of the American Friends Service Committee, a Quaker organization that works for social justice. "They can earn more in an hour here than for a whole day's work in Mexico."

We pulled off the road at scrubland that stretches along one of Carlsbad's new tracts of million-dollar homes. Sliding down a hillside, I grabbed on to the base of a prickly shrub called a manzanita. The manzanitas scratched us as we walked on a trail through black and purple flowers, cactuses, and butterflies. Martinez stopped and shouted a greeting in Spanish. Silence. He shouted again. A voice answered from within the bushes. A man emerged.

Behind him I saw a ring of stones, a campfire, and a pile of cans, eggshells, old socks, and broken glass. Behind the pile was a plywood shed, camouflaged with branches. Through the doorway I saw a dirt floor, candles, a blanket.

"Don't go in," the man said. "Rats and lice."

I wandered farther down the trail and heard voices. Dug into some of the hillsides were "spider holes" where people sleep. As I learned to distinguish the camouflaged clotheslines and sheds, I realized that hundreds of people covered this hill and the next and the next.

I shouldn't have been surprised. As many as 25,000 undocumented immigrants from Mexico are apprehended crossing into San Diego County every month. Increased earning power in the U.S. lures them north. Mexico's population of nearly 96 million is growing by two million a year, while practices such as poor land-use management decrease the amount of land under cultivation.

But Mexicans aren't the only ones coming to Carlsbad. Increasing numbers of people are moving here from other places in the U.S., drawn by the mild climate, striking scenery, and proximity to growing cities like San Diego.

Carlsbad voted in 1986 to set zoning requirements that have the effect of limiting population growth. But the forces pushing growth seem irresistible. Driving past the edge of Carlsbad, I came upon a huge new home improvement store. Mexican men stood in the parking lot hoping for a day's work. The brisk business in the lot made the vote seem futile.

Biodiversity

Population pressures affect more than people. Development in California endangers the coastal California gnatcatcher, San Diego fairy shrimp, brown pelican, red-legged frog, thread-leaved brodiaea, Orcutt's spineflower, spreading navarretia, and nearly 200 other plants and animals—more wildlife than anywhere else in the continental United States.

Such threats to wildlife have spawned a feeling among many that anything humans touch is doomed. "Save the Planet . . . " read a bumper sticker I saw in southern California, "Kill Yourself."

The state of the earth's biodiversity—living things and the relationships among them—demands attention.

■ **CIRCA A.D. 1000: Maya, Totonac, and other Mesoamerican people use cacao beans to make chocolate. Polynesian settlers in Hawaii and Easter Island clear forests with fire, exterminating native plants and animals. Need for charcoal used in metal production contributes to accelerated deforestation in Europe. The *Physiologus,* one of Europe's best known books, includes animals such as the *echinemon,* which is "hostile to dragons."**



LIMBE, CAMEROON

All over the world, frogs—amphibians that survived whatever killed off the dinosaurs—are suffering developmental defects and dying at an alarming rate. The problem is so nebulous that experts cannot predict how many of the world's 3,500 frog species face possible extinction.

Frogs live both in water and on land. Because they are unprotected by scales, feathers,

or hair, their skin is highly sensitive to water and air quality. Their recent problems may be a warning bell for what global warming and pollution could eventually do to humans.

Disruption and destruction of species are nothing new. Beginning in prehistoric times, aurochs—wild oxen often six feet high at the shoulders—lived in Mesopotamia, Asia Minor, North Africa, and Europe. The caves in Lascaux have paintings of them, and Julius Caesar marveled at their strength, but by the early 17th century hunting and deforestation in Europe had killed the world's last aurochs.

What is stunning is the scale and rate of today's extinctions. Just among birds and mammals the current rate is roughly a hundred times the natural level. In the United States alone, one-third of all plant and animal species are threatened. Humankind's collective impact is such that mass extinctions could occur within one human generation.

Last winter I rented a four-wheel-drive vehicle and drove across Madagascar, home to thousands of plants and animals found nowhere else. On the western shore I stopped at what was undisturbed rain forest until 20 years ago. Now, like much of Madagascar, it's mostly barren.

As I began my hike, two teenage boys suddenly emerged from a thatched hut. Several chameleons crawled along their arms and on the tree branches they held. They wanted me to pay for permission to photograph the chameleons. Their sales pitch was persuasive: I would have trouble seeing chameleons elsewhere on Madagascar because most of the forest has been destroyed.

When I described the loss of wildlife on Madagascar to a friend, he said, "If my kids grow up and never see some animals that once lived on Madagascar, so what?"

I took this "so what?" to Richard Vari, research scientist and ichthyologist at the Smithsonian Institution's National Museum of Natural History. He led me through a cavernous room. Around us 20,000 species of fish floated in various size jars of ethanol. A few big fish were folded over like clothes crammed into overpacked suitcases. Fish smaller than pencil erasers were held 4,000 to a jar. Weird-looking fish included an eel whose mouth expands to a width of eight inches.

Vari and I discussed recent exploration into the depths of Amazonia's rivers, which revealed transparent catfish and catfish that eat driftwood. "Why should we worry whether such fish survive?" I asked.

He smiled. He'd heard the question before. "Nothing directly has come from any of these fish," he said. "But you must see the broader context. Fish are part of biodiversity, the system we rely on for food and for our own survival."

I asked Vari to name one fish whose loss had affected the entire ecosystem, including humans. He mentioned *Henochilus wheatlandii*, a fruit-eating fish that lived in the rivers of eastern Brazil and became extinct in the late 1880s.

"But what effect did that have on humans?" I insisted.

Vari shook his head. I wanted an easy answer, a direct connection between the loss of species and harm to humans. But the reality isn't that simple.

"We still don't know the effect of such extinctions," he says. "It's like pulling bricks from a wall; you can keep doing it until the wall suddenly collapses."

Vari has devoted his life's work to nature for nature's sake. But he knows that to rouse the public, he and others must find meaningful ways to measure the practical, economic value of the web of life.

What is the economic value of soil formation, food production, flood control, climate maintenance, and all the other ways biodiversity serves humans? One recent study estimates the global value of "ecosystem services" to be between 16 trillion dollars and 54 trillion dollars annually. By comparison, the world's human-produced goods and services total an estimated 25 trillion dollars a year. This doesn't count all the species, such as medicinal plants, that we are destroying before we even know how they work.

The City of New York recently committed 660 million dollars to buy land and conservation easements and to take other measures to improve water quality in the city's watershed, primarily in the Catskill Mountains. Protecting the natural mechanisms and preventing pollution in the watershed means city officials won't need to build a multibillion-dollar water-treatment plant.

Human Culture

■ **CIRCA A.D. 1000: While far from creating a world culture, trade increasingly moves ideas. Scandinavians carry notions of a popular assembly to present-day Russia. It does not last. The chair becomes commonplace in China. Bean cultivation spreads in North America. The slave trade flourishes; Slavs and Africans are major sources. Ten percent of England's people are slaves, mostly from Europe. Economic hardship prompts many families to sell children.**

The people who may know the most about biodiversity are those living closest to it—the very people whose cultures are now being destroyed by the intrusion of outsiders and technology.

Sailing to a village on a small island in Indonesia's Banda Sea in 1990, I hopped off the boat and walked the last 20 feet through water because the village had no pier. The sweet aromas of clove and nutmeg trees filled the air.



PALENQUE, MEXICO

One of the village elders I met explained rules that are passed orally from generation to generation: No tree could be cut from areas that serve as sources of fresh water. Breeding places for fish were off-limits. Certain forest areas, home for medicinal plants, were to be protected.

Recently gold miners from Java bulldozed many of the trees, endangering the fresh water. If this continues, how much of what the villagers know will be lost forever?

Such rapid change has generated a global awareness that can give ordinary people international influence.

Two years ago Craig Kielburger, a 14-year-old in Thornhill, a town just north of Toronto, Canada, read a newspaper story about Iqbal Masih, a Pakistani boy who was shackled to a carpet loom at age four. His family had sold him. Iqbal escaped and began to organize other working children. He attracted media attention and was murdered at age 12, presumably because of his efforts. That prompted Craig and a group of friends to form Free the Children to try to end the exploitation of children.

In the developing countries about 250 million children work, nearly half of them full-time, according to the International Labor Organization. This situation also exists in the developed world. In the United States, for example, thousands of children work illegally in agriculture, where many are exposed to hazardous pesticides.

Craig greeted me at the door of his house. Inside, letters, faxes, newspapers, overnight-delivery envelopes, and brochures filled the kitchen, living room, family room, and dining room, and the telephone rang constantly. The letters came from dozens of countries, sparked by media coverage of Craig's travels. One schoolchild wrote, "I would like to make a difference."

Craig's many projects include letter-writing campaigns to governments and corporations in support of Rugmark, a label that tells consumers that rugs were not made by children; sending school supplies overseas; and fund-raising to build an education and rehabilitation center in Alwar, India, for children freed from bonded labor.

Craig is slender, with wavy light-brown hair. He loves basketball and computer games but hasn't had much time for them recently. Just back from Africa, he showed me photographs of himself with a young boy carrying a stick. "He uses the stick for herding cattle," Craig explained, telling me that the boy is a slave. "He was seven years old when a man took him and his brother away. His master beats him. He hasn't seen his family for four years. He earns the equivalent of six dollars a month and can't leave because of the down payment made to his parents."

Sale of children by parents is common

throughout Asia and Africa, where millions of children serve in debt bondage. Poverty and high interest rates on loans, coupled with illiteracy, perpetuate this form of slavery. Craig showed me other photographs. There was one of a young girl squatting barefoot in a recycling factory in India, removing used needles from syringes gathered from streets and hospitals. She had never heard of AIDS.

"How do you keep from becoming discouraged?" I asked Craig.

He paused before replying: "It's the chance to meet with the children. Once they've brought you into their world, it's a gift they give you. The only thing you can give back is the pledge to get involved."

Science

Science has produced the communications technologies that make Craig Kielburger's global outreach possible. Modern science, which uses experimentation, replication of results, analysis of cause and effect, and factual documentation to test hypotheses, stands out as one of the millennium's most influential belief systems. This is a belief not in any particular theory or set of facts but in a process through which we conduct what Linus Pauling, winner of the 1954 Nobel Prize in chemistry, called the "search for truth."

■ **CIRCA A.D. 1000: India has created a numerical system based on nine numbers followed by a symbol for "zero." China has developed science and technology, including gunpowder, paper money, movable type, and blast furnaces capable of producing cast iron. Among China's books is the *New and More Detailed Pharmacopoeia of the Khai-Pao reign-period.* Translations of Arabic texts into Latin help spread knowledge of such instruments as the astrolabe.**



GENETICS RESEARCH, U.S.A.

To witness a phenomenon that has thus far defied scientific understanding, I watched Kristina being stung by bees. Kristina is in her 70s and was diagnosed with rheumatoid arthritis in 1980. The joints of her fingers are red and misshapen. Still, she looks young, and because she doesn't want her friends and colleagues to know how old she is, she asked me not to use her real name. Rheumatoid arthritis is a chronic, inflammatory disease that occurs when the immune system attacks the body it's designed to protect. No one knows how the condition begins or why its severity varies.

Kristina has received anti-inflammatory drugs, standard treatment for arthritis. "Those treatments must help some people, but they did nothing for me," she said. "The pain and stiffness kept getting worse."

Now she was trying another approach. Four bees locked in tweezers were lined up at the edge of the table, ready to sting her. Dozens of other bees were trapped in a plastic jar.

Amber Rose, an acupuncturist in Fort Lee, New Jersey, who has been practicing apitherapy, the medicinal use of bee venom and other bee products, since 1993, held a frozen steel rod on Kristina's hand to numb the spot where the first sting would occur. Rose lifted the tweezers and held the bee, rear-end down, over Kristina's hand. When Rose took the tweezers away, the stinger was in Kristina's hand. The muscle at the top of the stinger, detached from the bee's body, twitched as it emptied the tiny sac of poison.

Kristina didn't flinch as Rose reloaded the tweezers and administered a total of 34 stings.

"Why isn't the pain from the stings bothering you more?" I asked.

"Of course it hurts sometimes, especially on the inside of your hands, but don't forget I know how arthritis feels," she said. She used her hands to gesture as she talked, apparently with no pain. "What were your hands like

before you started getting the stings?" I asked. "I had trouble moving them," she said.

Bee venom, honey, and other bee products have been used as folk remedies in China for thousands of years, according to many advocates of apitherapy. Hippocrates and Pliny the Elder mention the benefits of bees in their writings.

Rose was doing something else that makes this difficult for science to understand: she was giving the bee stings in acupuncture points. "In 1993 I visited the Technical Institute in Beijing," she explained. "They kept their bees on the roof. During treatment the acupuncturist took the stinger out of the bee and then used it for four or five acupuncture points. That was very diluted compared with what I'm doing here. I'm doing one stinger a point."

While nothing is known about what effects bee stings have on acupuncture points, we now know that bee venom contains numerous enzymes, peptides, and active amines. The most potent in humans appear to be melittin, phospholipase A_2, apamin, and peptide 401. Various studies suggest that these chemicals cumulatively stimulate the body to produce cortisol and other anti-inflammatory hormones.

Such reactions may be the reason stings provide relief for people suffering from a variety of ailments, including gout and multiple sclerosis. But science, by definition, tries to isolate variables, and it may be impossible to isolate the active compounds—and the interactions among them—that give bee venom its therapeutic effects.

"The lesson," said a scientist with whom I discussed bee-venom therapy, "is how little we know. In much of our knowledge of the world, we're still in the dark ages."

Somehow it's comforting to think we are in the dark ages. If we really know very little, then extraordinary possibilities still exist.

FAITH IN CHANGE is characteristic of our age. We pride ourselves on speed. "A billion hours ago, human life appeared on earth," the 1996 Coca-Cola Company annual report reads. "A billion minutes ago, Christianity emerged. A billion Coca-Colas ago was yesterday morning." ■ But maybe what is most important doesn't change. I learned this from Bob Haggart, a good friend in my hometown of Syracuse, New York. Bob had been diagnosed with multiple myeloma in 1988 and was not doing well. He wouldn't live to see the new millennium. I wanted to get his perspective, as someone who knows death is real, about what is important and enduring. ■ But before I could do so, his wife, Brenda, called. Bob was in the hospital. He was too sick to see visitors or to write his regular newspaper column for the Syracuse *Post-Standard*. Then on Valentine's Day a column by Bob—written on a word processor sneaked into his hospital room by one of his colleagues—appeared in the *Post-Standard*. ■ "This is my Valentine to Brenda," it reads. "Unfortunately, this Valentine will not look or taste as good as those hearts that grade-school teachers in Kansas helped me cut out and paste on big pieces of red paper. . . . So here is my Valentine, composed in my head as Brenda sleeps beside me on my hospital bed. The paper and paste of my Valentine hold straight and true the best words I have ever written in my life. Bob loves Brenda forever." ■ Eleven days later Bob died. I never got to see him or thank him for answering my question. Love endures.

Exploration

Why do we explore?



■ ALABAMA, U.S.A.
The limestone walls of Never-sink, a 162-foot-deep open-air pit, provide habitat for a rare fern. "The frontiers," wrote Henry David Thoreau, "are not east or west, north or south, but wherever a man fronts a fact."

Physical World

What life-forms can survive dramatic environmental change?





■ WYOMING, U.S.A.
The center of Yellowstone National Park's Grand Prismatic Spring steams at 199°F, too hot for the multicolored bacteria clustering on the cooler perimeter. But dead center is no dead zone: Billions of organisms called thermophiles flourish in the scalding water.



Population

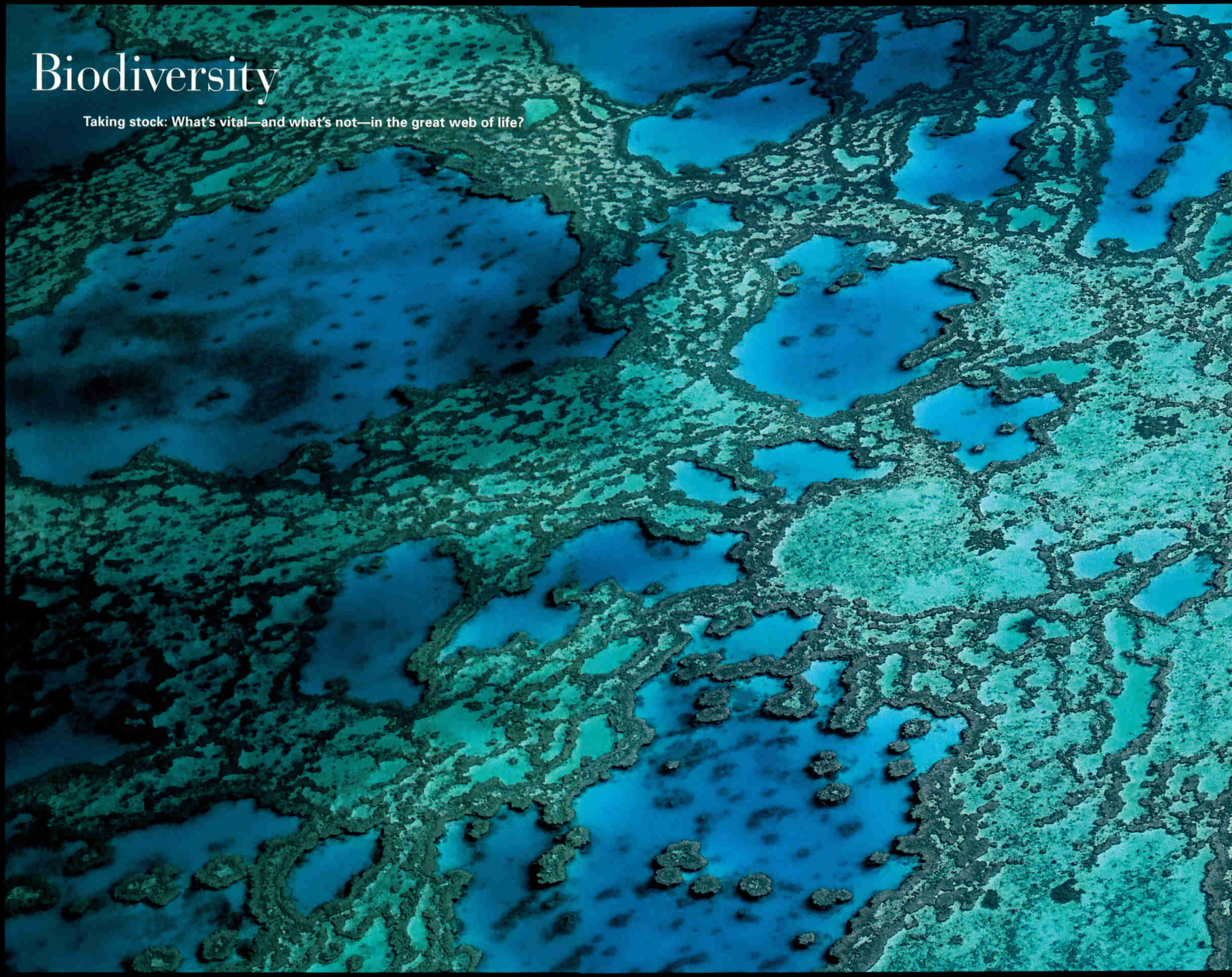
As the number of human beings grows, what are the impacts?

■ MAURITANIA, WEST AFRICA

Fishing boats blanket a beach near the capital city of Nouakchott, where the population has grown from 10,000 in 1960 to more than 700,000. Many residents were driven from rural areas by persistent droughts.

Biodiversity

Taking stock: What's vital—and what's not—in the great web of life?



■ NORTHEAST AUSTRALIA
Stretching for 1,250 miles, the Great Barrier Reef is home to 1,500 species of fish, 4,000 species of mollusks, and 500 types of seaweed. Australia protects nearly all of this reef system within a marine park.

Human Culture

We learn. We believe. We create. What endures?





■ CALIFORNIA, U.S.A.
In pre-Columbian times, Native Americans etched the Mojave Desert with images of their creator, Mastamho, and his spirit helper, a mountain lion. Tire tracks from recreational vehicles add the scrawls of modernity.

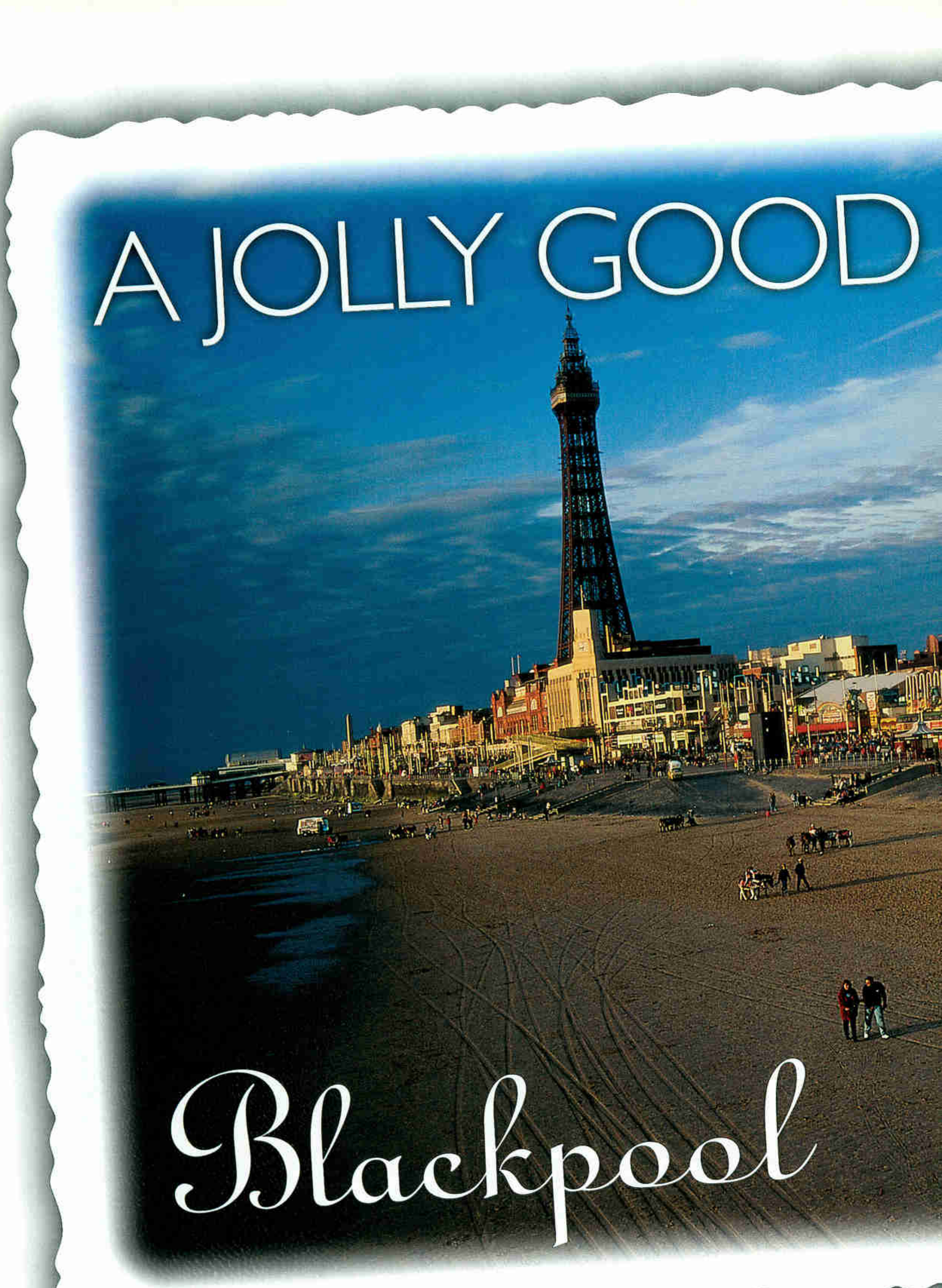
Science

What are the new promises and perils of science and technology?



■ NEW MEXICO, U.S.A.

At Sandia National Laboratories a fusion research accelerator generates—for an instant—more than ten times the power of all the world's electrical generating stations combined. The lab's dream? To develop a cheap, clean, and inexhaustible source of energy. □


A JOLLY GOOD
Blackpool

TIME IN

BY BILL BRYSON

PHOTOGRAPHS BY TOMASZ TOMASZEWSKI

ENGLAND

"Dear Prudence, Walked along the seaside. Saw the Eiffel Tower (Ha!). Chilly on England's west coast. Marvelously tacky here. Gaudy arcades, silly T-shirts. Would you believe 17 million visitors a year? Hitting a disco tonight! Cheers, Cliff"

Bursting from a campy confection of tropical hues with Carmen Miranda head-wear, female impersonator Simon Green belts out "Welcome to Havana" in



his "Betty Legs Diamond" persona. The revue draws sellout crowds to Funny Girls, a club on the outré edge of Blackpool's exuberant nightlife.

Consider the whelk. Rubbery and almost tasteless, the whelk is at the very limit—possibly just beyond—of what could be classified as an edible substance. Imagine a wodge of chewing gum about the size of a Ping-Pong ball that you have been chewing for ten hours. That is the whelk.

Imagine the coldest water that you have ever waded into—water that greets you like a stab of pain and brings to your lips a long, involuntary sound like air escaping from a pinched balloon. Imagine wind-driven sand that stings your cheeks, dusts your hair, and leaves you feeling, at the end of the day, like a newly stuccoed house. Imagine noise that hits you like a car crash and colored lights that jangle your senses. Imagine paying good money for this. Imagine enjoying it.

Welcome to Blackpool.

The British invented the seaside holiday, and frankly I can't imagine what they were thinking. To sit half naked for hours on a pile of sand is, to my mind, as alien to pleasure as an experience can be. To do it in a climate like Britain's is clearly a form of madness.

Yet millions of Britons faithfully, even eagerly, troop to the coast each year to enjoy the traditional pleasures of a day at the seaside—saucy postcards, kiss-me-quick hats, Gypsy fortune-tellers, cantankerous deck chairs, donkey rides on the beach, funfairs, chewy whelks—and nowhere attracts them in greater numbers than Blackpool.



Sprawled along seven breezy miles of the Lancashire coast, just over the horizon from the old industrial cities of northern England—Liverpool, Manchester, Bradford, Leeds—Blackpool is the largest, liveliest, most incontestably in-your-face seaside resort in Europe. It attracts more tourists than Greece. Seventeen million visitors, equivalent to almost one-third the population of Britain, come to the town for at least a day each year. It has the largest roller coasters, the brightest lights, the biggest crowds, the intensest noise, the tackiest souvenirs of any fun spot that ever rose beside the sea. There is no other place quite like it—and, you might sometimes feel tempted to add, thank goodness.

"You either love this place or hate it," admits Jane Seddon, the local tourism officer. Actually, there is a third option. You can be totally mystified by it.



Butterflies churn even in stomachs strong enough for the Big One, a 235-foot-high roller coaster at the Pleasure Beach. Drawing heavily from England's industrial north, the 42-acre amusement park is among the United Kingdom's biggest tourist attractions.

Bill Bryson, a frequent contributor, is also a longtime commentator on England's curious places. Tomasz Tomaszewski, whose photographs appeared in the magazine's special coverage of Mexico (August 1996), found Blackpool to be his most unusual assignment for National Geographic.



BLACKPOOL'S NORTH PIER on a Friday afternoon in July. In the Sun Lounge, an open-air area sheltered from the wallop of sea winds by salt-dirtied glass barriers, Raymond Wallbank is manipulating an outsize Wurlitzer, playing standards like "Moon River" and Blackpool's perky unofficial theme tune, "I Do Like to Be Beside the Seaside." He has been there for 31 years, according to a sign. Many of his lightly snoozing audience look as if they have been there about as long.

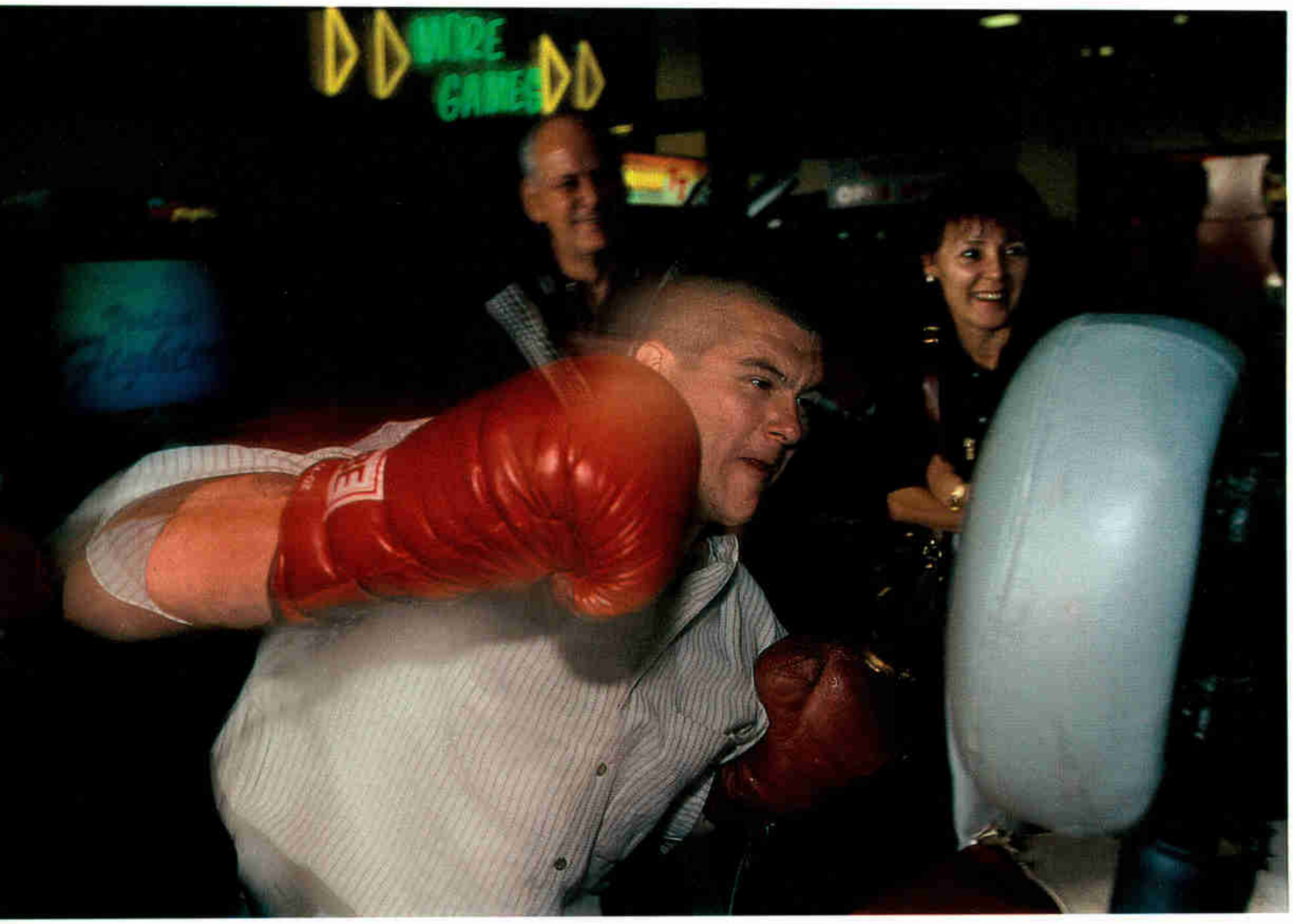
Along the open pier, beneath a sky the color of soiled sweat socks, holidaymakers, mostly elderly, sit with newspapers or vacant stares on the ornate cast-iron benches, their backs tensed against a stiff breeze. A few are struggling with small plastic platters of cockles or whelks or other traditional seaside fare. They are, believe it or not, having the time of their lives.

"Enjoying yourself?" I ask one man in a flat cap.

"Oh, smashing," he says, suddenly brightening.

"Absolutely lovely," agrees his wife in an emphatic Lancashire accent, a hand pressed to her head to keep her hat from Frisbeeing off along the sands. "Wind's a bit sharp, mind, but otherwise absolutely lovely."

Seven hours later, along the entertainment area called the Golden Mile, the change of mood is dramatic. Overlooked by Blackpool Tower,

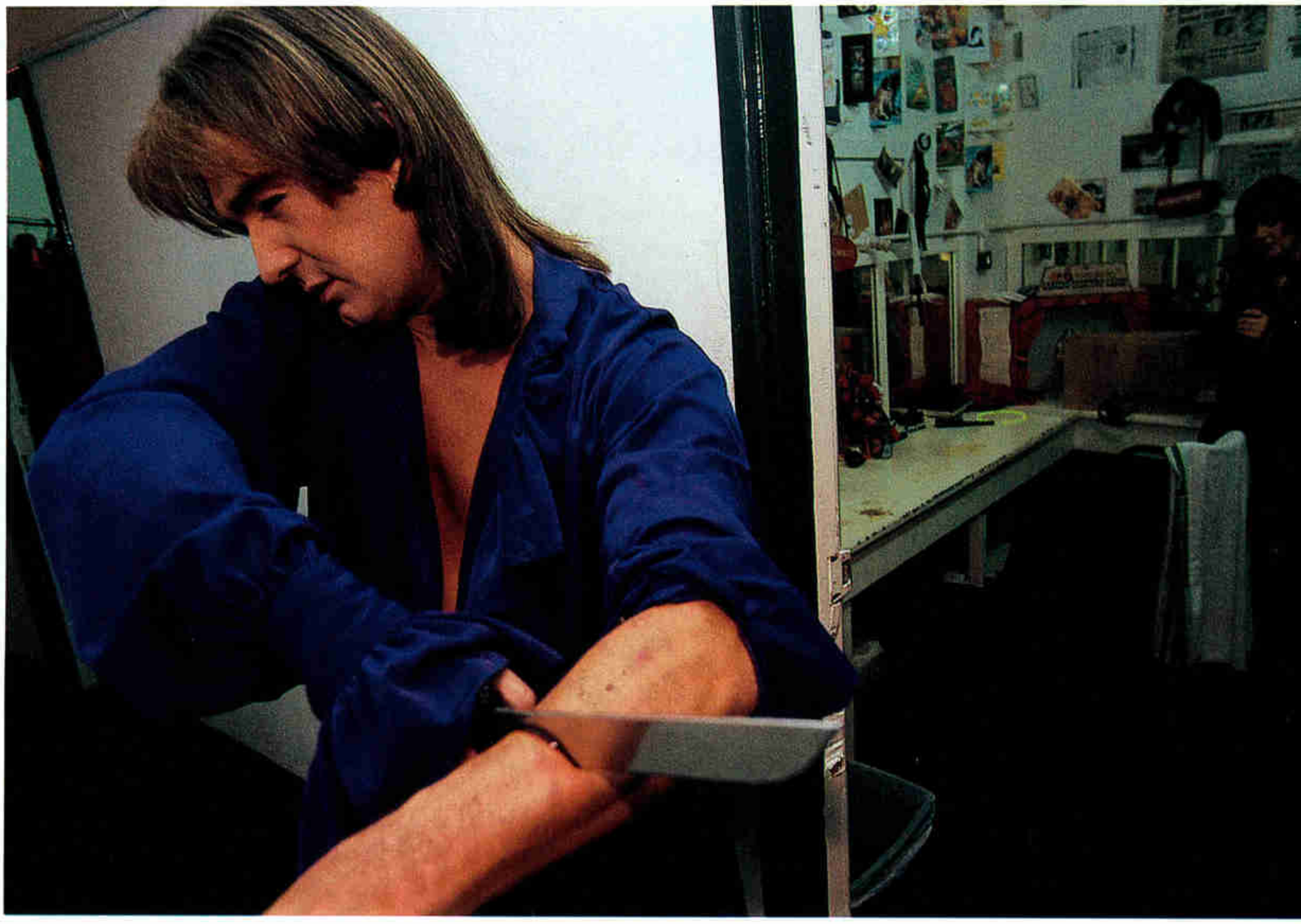


a half-size copy of the Eiffel Tower that has dominated the skyline for a century, this seafront stretch of amusement halls, bingo parlors, and discotheques has the noise, the pulse, the happily charged commotion of a fairground.

To stroll along among its crowds is to be assaulted by a new sensation every three paces: the pinball clatter of an arcade, the throb of disco music, the sickly sweet blast of a cotton candy stall, the silky importunings of a shill, the vaguely acrid smell of vinegar-soaked chips, the sudden, startling dampness of a collision with three bumptious, cheerful, beer-carrying youths—"Oops, sorry mate!"—the ceaseless noise, the inescapable press of strangers, the beckoning lights that flash and hum and endlessly burst and coalesce in bright, building-size patterns. Depending on your perspective, it is either nirvana or a migraine in three dimensions.

IT IS INTERESTING to reflect that there is a direct link between the relentless liveliness of Blackpool and a long-forgotten 18th-century book with the somewhat unlikely title of *A Dissertation Concerning the Use of Sea Water in Diseases of the Glands* by an equally long-forgotten physician named Richard Russell.

Before Dr. Russell's day—indeed, at least as far back as Roman times—Britons had been taking themselves off to inland spas like Bath and Harrogate to immerse their gouty frames in the warm, generally sulfurous waters of natural springs. But in the early 1700s Russell began propounding the unorthodox view that hot springs were actually deleterious to health and that cold, bracing seawater was just the



Suffering for his art? So it seems as Richard De Vere wields his knife. The illusionist routinely impales young women on swords in the Mystique Show. The Coin Castle Arcade offers less artful diversion; slamming away at Sonic Blast Man is a harmless way to let off workaday steam.

thing to remedy nearly every malady from leprosy to lassitude.

Conveniently—but somehow not surprisingly—it happened that Dr. Russell had a practice by the sea. He encouraged his willing patients not just to bathe in seawater but also to drink it, often in alarming quantities, and to stroll beside it to benefit from its healthful vapors. Soon other medical men were doing likewise, and, before long, quiet fishing villages like Scarborough and Brighton were being transformed into fashionable retreats, complete with seafront promenades and elegant piers where people of a certain class could saunter and be seen.

By the mid-1800s at least a score of resorts, Blackpool among them, had sprung up all around Britain's coast. While most other resorts strove for a kind of tranquil gentility, Blackpool became an unabashedly boisterous place—where, as the local *Herald* newspaper noted with a touch of alarm in 1875, "people expect to have a jolly care-for-nothing sort of scamper." It catered to a new class of holidaymakers—workers from nearby factory towns, who came each year on what were known as wakes weeks (from an old northern English word for a religious festival specific to a particular town or parish), when whole towns would shut down and everyone would go away on holiday together.

"Right from the beginning Blackpool knew what it was about," says Roger Bingham, a historian of popular culture who grew up nearby. "You didn't go to Blackpool to be elevated. You went for a good time."

The town began erecting entertainments for the masses—music halls, funfairs, three ornate piers, a 220-foot-tall Ferris wheel, the Tower. It built an opera house but never performed opera there. "They did a little Gilbert and Sullivan and that sort of thing," says Bingham,

Billows of spume from the Irish Sea bash the seawall, misting a horizon commanded by the Big One. Calmer waters lie nearby in the Sandcastle

Leisure Complex. It touts an "inside seaside" with three swimming pools—one with artificial waves—in a balmy 84°F atmosphere.

"but essentially Her Majesty's Opera House was just a grand name for a music hall."

Perhaps no place better represents what Blackpool is about than the venerable fun spot called the Pleasure Beach, which isn't a beach at all but an amusement park, crammed onto a 42-acre site along the seafront. For anyone who has grown accustomed to the spacious, just painted cleanliness of a modern American theme park, Blackpool Pleasure Beach can seem, well, cramped and dowdy. This, I discovered when I met Bill Marion of West Babylon, New York, is actually a virtue. "It's just like Coney Island used to be," Marion said to me in a tone that went some distance past awestruck. "It has personality. It's a place out of time."

Marion, it turned out, was one of 168 genially demented people, all members of a group called the American Coaster Enthusiasts, who had come to Britain to ride roller coasters for ten days. The park's publicity people were enormously proud of their new 12-million-pound (19 million dollars U.S.) roller coaster called the Big One, which they claimed to be the tallest and fastest in the world, but to my surprise Marion and his fellow enthusiasts were far more enchanted by some of the smaller, more creaking diversions.

"Some of these rides haven't been manufactured for 50 years," Marion explained. "That Tumblebug over there is one of only four remaining in the world. The Noah's Ark is one of just three. So is the Derby Racer." The Pleasure Beach, he went on, has two roller coasters that the Coaster Enthusiasts call "classic"—their highest accolade. In the whole of the United States there are just 23 such rides.

If there is one person at the Pleasure Beach who appreciates a good ride it is Doris Thompson, whose father founded the park in 1896 and whose son today runs it. Now 95 and confined to a wheelchair, she remains a sprightly figure with a bonny nature and an irrepressible chuckle. She first rode the Helter Skelter at the Pleasure Beach in 1906 at the age of three and made it a point of honor to test every new ride until she was well into her 80s. Her last ride was in 1990, in the company of the Bishop of Blackburn, on a terrifying piece of mayhem called the Avalanche.

"I think it was perhaps a bit vigorous for him," she told me in a sympathetically confiding tone, "but I adored it."

CHANGING WITH THE TIMES while retaining a sense of timelessness is something Blackpool has always done exceptionally well. Anyone who knew the resort 50, 60, or even 70 years ago would recognize it instantly today. The trams that trundle along the seafront are much as they were in the early years of this century. The Illuminations, a sort of carnival of lights that began in 1912 as a way of extending the season, continues to be a huge draw every autumn. The piers, the Tower, and the Pleasure Beach all offer much the same pleasures as they did a century ago, and nearly all the gift shops still specialize in a distinctive candy called (for reasons that become evident as soon as you try to bite into it) rock.

At the same time, there has been a certain loss of innocence. "There used to be a lot more of what you might call simple pleasures," Barry Shaw, a postal worker who grew up in the town in the forties and fifties, told me one day. "There were tearooms and cinemas—15 or 20 at



A September day means goose bumps for a fair-haired moppet, sand fantasies for a young girl, and reveries for those who merely watch. Few bathers are seen about. The sea temperature averages only 64°F in summer, the air just one degree warmer.



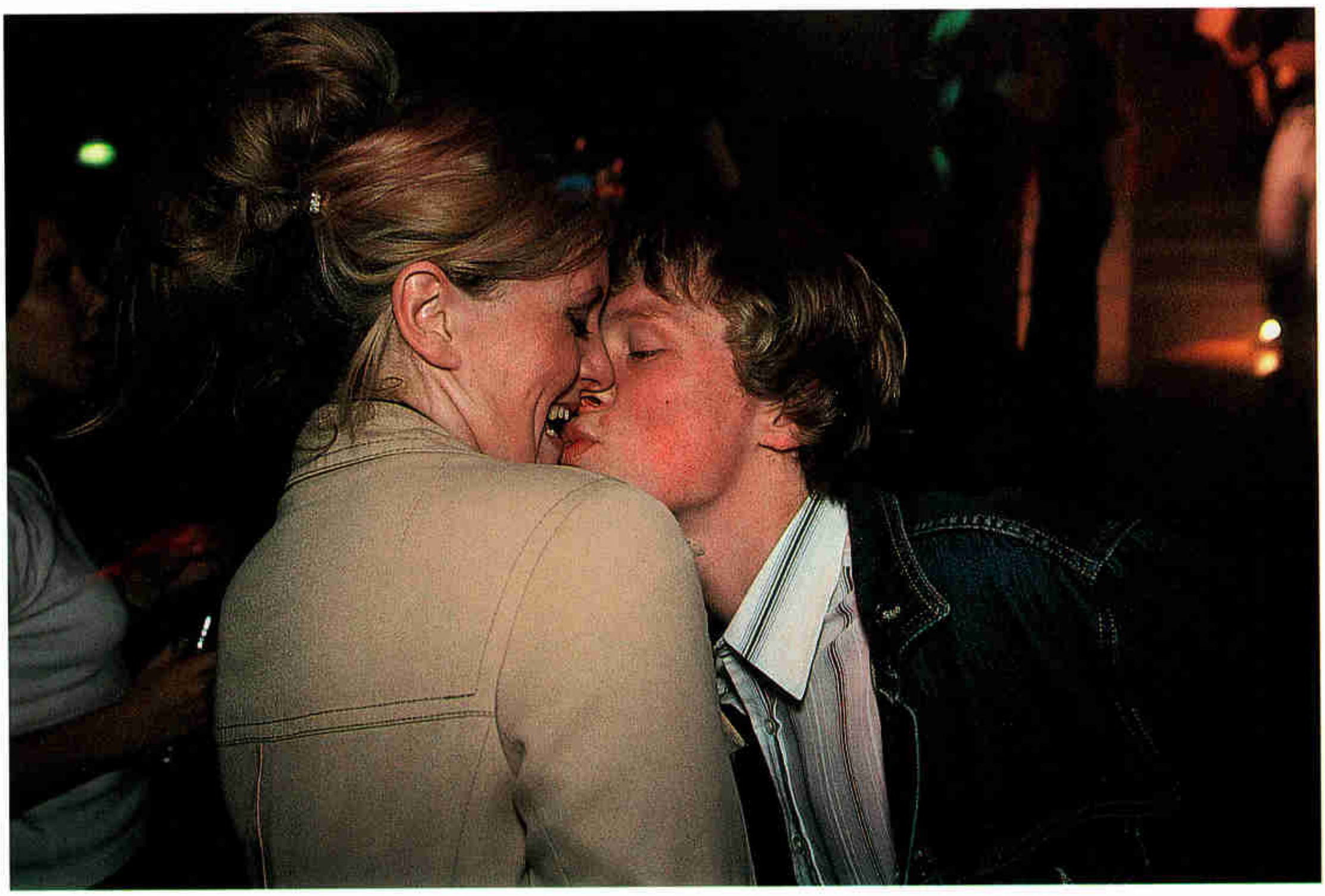
one time, as against just two now—and some lovely dance halls. People were more easily contented back then."

For better or worse, adapting to change has always been a feature of Blackpool. "This was the first resort to realize how the car would transform British life," says Roger Bingham, the historian. In the 1960s it tore down the main railway station, rerouted trains to a new, much smaller station a half mile inland, and redeveloped the site into one of Europe's largest parking lots. At one time as many as 320 trains a day would arrive in Blackpool and spill out occupants, most of whom would stay for at least a week. Now the overwhelming majority of visitors arrive by car, and increasingly they drive home at the end of the day—"often without having spent a penny on anything but perhaps a cup of tea and parking," says Hazel Parr.

Bustling and friendly, Parr is proprietor of one of Blackpool's 3,500 small hotels and guesthouses. Her trim guesthouse, called Haldene, is one block in from the seafront, on a street on which every house—perhaps 50 altogether—is also a guesthouse. There are scores of streets in Blackpool like this, where virtually every property is a B and B.

Parr is the antithesis of the infamous Blackpool landlady of yore. By tradition Blackpool landladies were a formidable breed, barking out orders, imposing strict rules, and generally cowing guests. There was a







Gilded splendor sets the stage for a Wednesday morning dance session in the Tower Ballroom. Cheekier moves come at the Palace; Britain's largest disco can hold 3,000 revelers. Impressive numbers also apply to hotel space: 100,000 beds in a town of fewer than 150,000.

time not so long ago when guests were expected to depart immediately after breakfast and were not allowed back until nearly dinnertime.

"On rainy days you used to sometimes see families standing under awnings or in bus shelters just waiting for it to be four o'clock," an English friend told me, grinning at the ridiculousness of it. "It was quite pathetic really."

Now guests expect, and invariably get, private baths, color TVs, complimentary coffee, tea, and snacks, and unlimited access to their rooms. Parr charges £18 a night for bed-and-breakfast and just £5 for dinner, but at the time of my visit only 3 of her 13 rooms were occupied, and I was the only one to avail myself of her munificent evening meals.

"Blackpool still gets plenty of visitors, but now even if they stay, it's only for a night or two," she says. "Blackpool has become a short-stay destination."

Nearly everyone you talk to in Blackpool notes how visitor habits have changed. Syd Little and Eddie Large, a popular comedy duo, have been performing at Blackpool for over 30 years and have seen great changes in their audiences.

"People have traveled a lot more now and expect more," Large told me one night after their two-hour show. "They aren't afraid to express themselves. The other night we were saying, 'Are there any people from Scotland here? Any people from Yorkshire?' and so on, like you do, and a voice from the audience shouted, 'Are there any comedians here?' " He beamed with pleasure at the memory of it. "That just wouldn't have happened 20 years ago."

OTHERS ARE LESS SANGUINE about the changes. John Gaulton runs Roberts' Oyster Rooms on the seafront, a business that was started by his great-great-grandfather in 1876 and has been in the family ever since. He still sells 1,500 portions of oysters a week, as well as whelks, cockles, potted shrimps, and other fruits of the sea, but the trend is inexorably downward. "I can see the day when this will be a wine bar," he says sadly.

Like many who earn their living from traditional businesses in the town center, Gaulton complains about the growth of public drunkenness and disorderly behavior by young people. "You get a lot of rowdiness on Friday and Saturday evenings now," he says. "A lot of it's just high spirits—you know, kids wrestling on corners or shouting at each other across the road—but it's frightening for families and older people, and it's terrible for business."

In 1994, the latest year for which records were available when I visited, there were 8,017 reported incidents in the town center—roughly double the number for other nearby towns with similar populations—of which 966 involved drunkenness, disorderly behavior, or fighting. The wonder is that it isn't much more.

At 2 a.m. on weekend nights as many as 20,000 young people can hit the streets simultaneously when the 56 town center discotheques and other nightspots close their doors. I spent a couple of evenings investigating Blackpool nightlife, but apart from a sore head from all the loud music and an indubitable conviction that I am much too old for this sort of thing, I saw nothing more striking than a curbside argument between a young man and his girlfriend over which of them was more capable of driving home safely. (Answer: neither.)

Showbiz pizzazz brightens the sky with electronic pinups of the stars of *Coronation Street*, a venerable British-television prime-time soap opera set



in nearby Manchester. Different themes highlight each year's Illuminations, begun in 1912 as a savvy ploy to extend the tourist season well into autumn.

The remarkable thing was how quickly and peaceably the departing throngs evaporated into the night. On this evening a passing bobby gently encouraged the argumentative couple to take a cab, which they did. Ten minutes later all was quiet in Blackpool.

"TWENTY YEARS AGO, Blackpool turned its back on the sea and tried to make itself into an entertainment center," says Robin Wood, a local official. "Now the thinking is that we should try to refocus on the sea and make Blackpool a family destination again." To say that Blackpool neglected the sea is to put it mildly. In 1976 the European Community, as it then was called, instructed member nations to make their beaches conform to certain minimum standards of cleanliness within ten years. Britain, rather than complying, took the novel strategy of contending that many of its most popular beaches were not swimming beaches at all. Because of Britain's climate the sea-bathing season is short, and most people don't go in above their knees anyway—and hence can't really be said to be swimming. By averaging out the number of people actually swimming across 365 days of the year, the government was able to persuade itself, if no one else, that Britain had hardly any real swimming beaches.

As one environmentalist put it to me: "You had the ludicrous situation in which Luxembourg had more listed public bathing beaches than the whole of the United Kingdom. It was preposterous."

Meanwhile, Blackpool continued to discharge raw sewage straight into the sea. Finally, after much pressure from both environmental groups and the European Union, the local water authority built a new waste-treatment facility for the whole of Blackpool and neighboring communities. The facility came online in June 1996. For the first time since the industrial revolution Blackpool's waters are safe to swim in.

That done, the town is now turning its attention to making the seafront more visually attractive. The promenade, once a rather elegant place to stroll, had become increasingly tatty and neglected. "It was built in Victorian times and needed a thorough overhaul anyway," says Wood, "so we decided to make aesthetic improvements at the same time, to try to draw people back to it." Blackpool recently spent £900,000 on building new kiosks for vendors and improving seating around the Central Pier and plans to spend a further £11,000,000 on various amenity projects.

The most striking thing about Blackpool these days compared with 20 years ago is how empty its beaches are. When the tide is out, Blackpool's beaches are a vast plain—a veritable Serengeti—of beckoning sand. They look spacious enough to accommodate comfortably the entire populace of northern England. Ken Welsby remembers days when, as he puts it, "you couldn't lay down a handkerchief on this beach, it was that crowded."

Welsby comes from Preston, 20 miles down the road, and has been visiting Blackpool all his life. Now retired, he had come for the day with his wife, Kitty, and their three young grandchildren, who were gravely absorbed in building a sandcastle. "Two hundred thousand people they'd have on this beach sometimes," Welsby said. "You can't imagine it now, can you?"

Indeed I could not. Though it was a bright sunny day in the middle of summer, I counted just 13 people scattered along a half mile or so



Victorian filigree accents a North Pier boardwalk, a hint of the resort town's 19th-century flowering. As summer wanes, the Tram Stop Bar indulges a visitor who dozes, perchance to dream of returning yet again next season.



of open sand. Except for those rare times when hot weather and a public holiday coincide, it is like this nearly always now.

"You can't imagine how exciting it was to come here for the day when we were young," Kitty said. "Even from Preston, it was a big treat. Now children don't want the beach. They want arcade games and rides in helicopters and goodness knows what else." She stared out over the glittery water. "We'll never see those days again. It's sad really."

"But your grandchildren seem to be enjoying it," I pointed out.

"For the moment," said Ken. "For the moment."

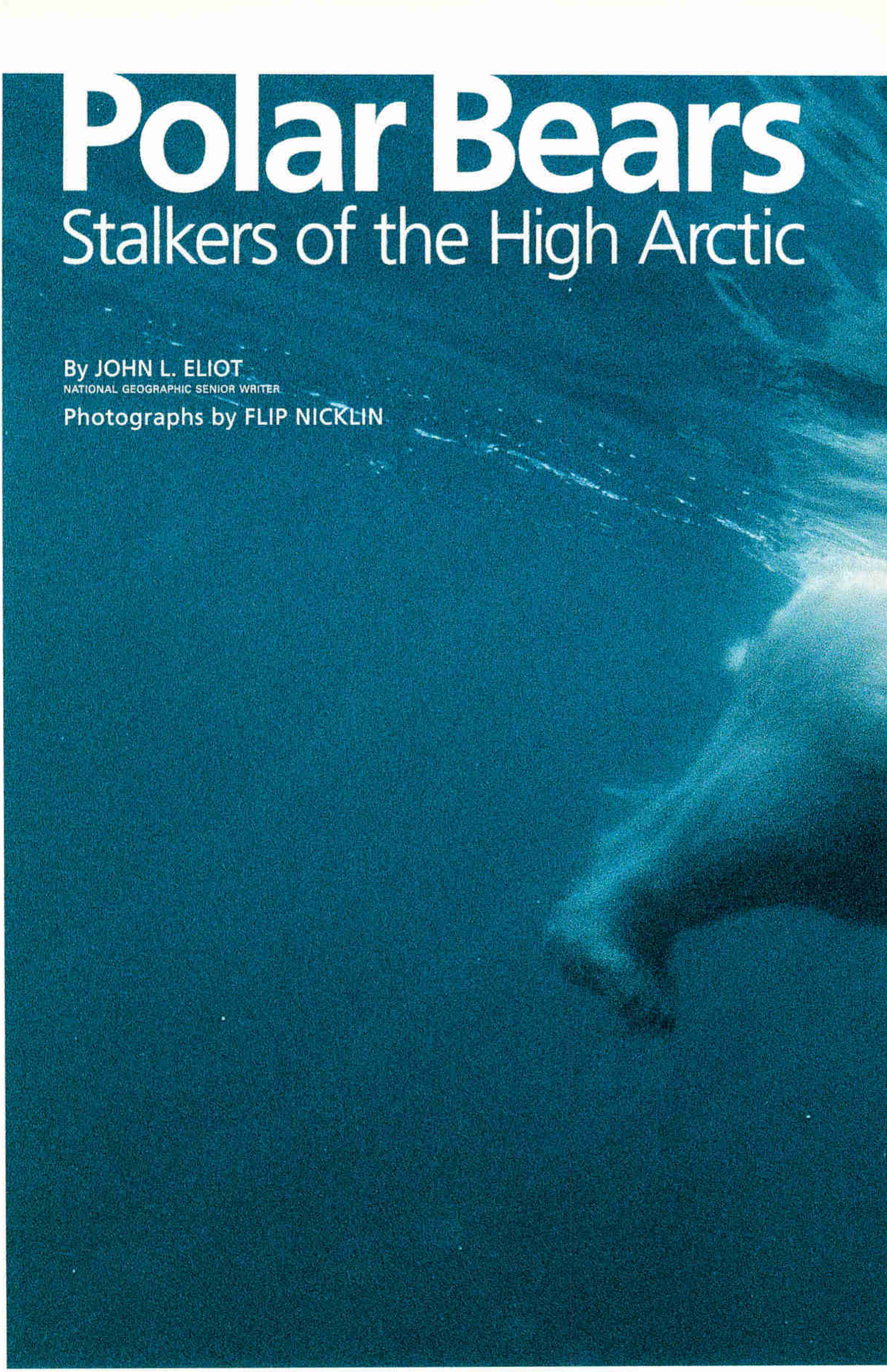
Afterward I went for a long walk along the empty beach, then went back to the town center and treated myself to a large portion of fish-and-chips wrapped in paper. The way they cook it in Blackpool, it isn't so much a meal as an invitation to a heart attack, but it was delicious. Far out over the sea the sun was setting with such splendor that I would almost have sworn I could hear the water hiss where it touched.

Behind me the lights of Blackpool Tower were just twinkling on, and the streets were beginning to fill with happy evening throngs. In the purply light of dusk the town looked peaceful and happy—enchanting even—and there was an engaging air of expectancy, of fun about to happen. Somewhat to my surprise, I realized that this place was beginning to grow on me. □

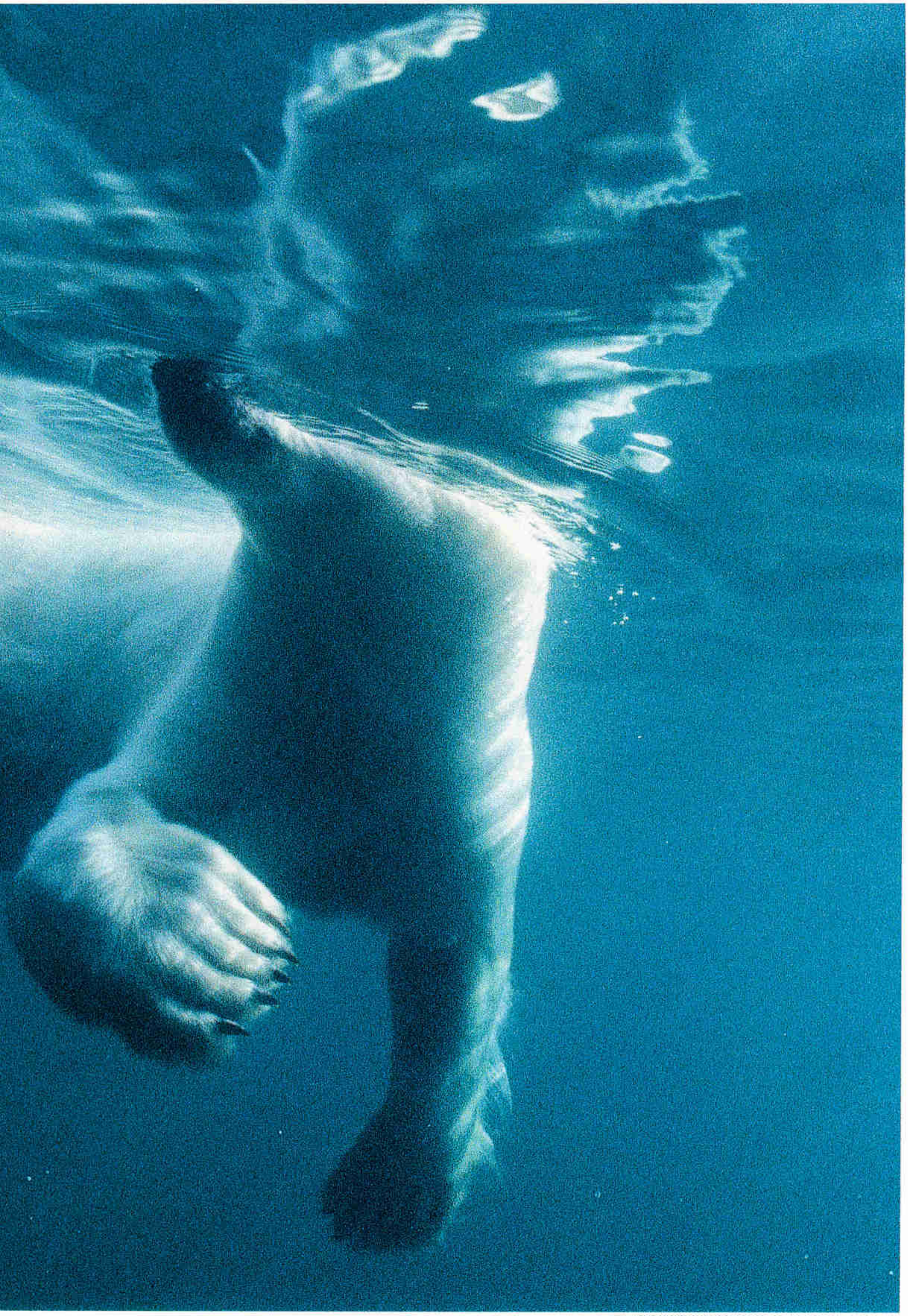
Polar Bears

Stalkers of the High Arctic

By JOHN L. ELIOT
NATIONAL GEOGRAPHIC SENIOR WRITER
Photographs by FLIP NICKLIN

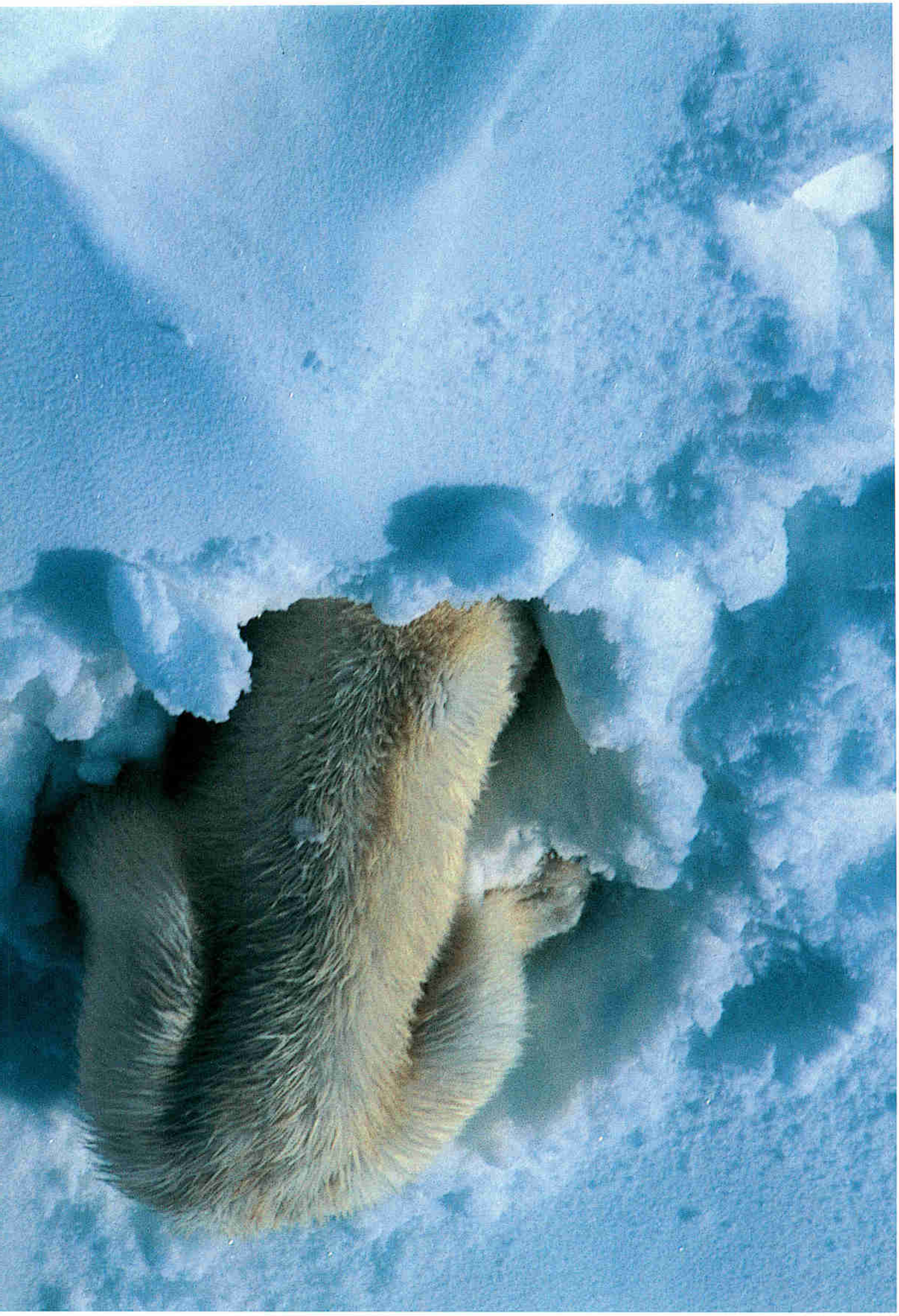


IN ITS ELEMENT Swimming among ice floes near Hudson Bay, a polar bear



FLIP NICKLIN WITH JOSEPH S. STANCAMPIANO, NGS STAFF

lives up to its scientific name: *Ursus maritimus,* sea bear.



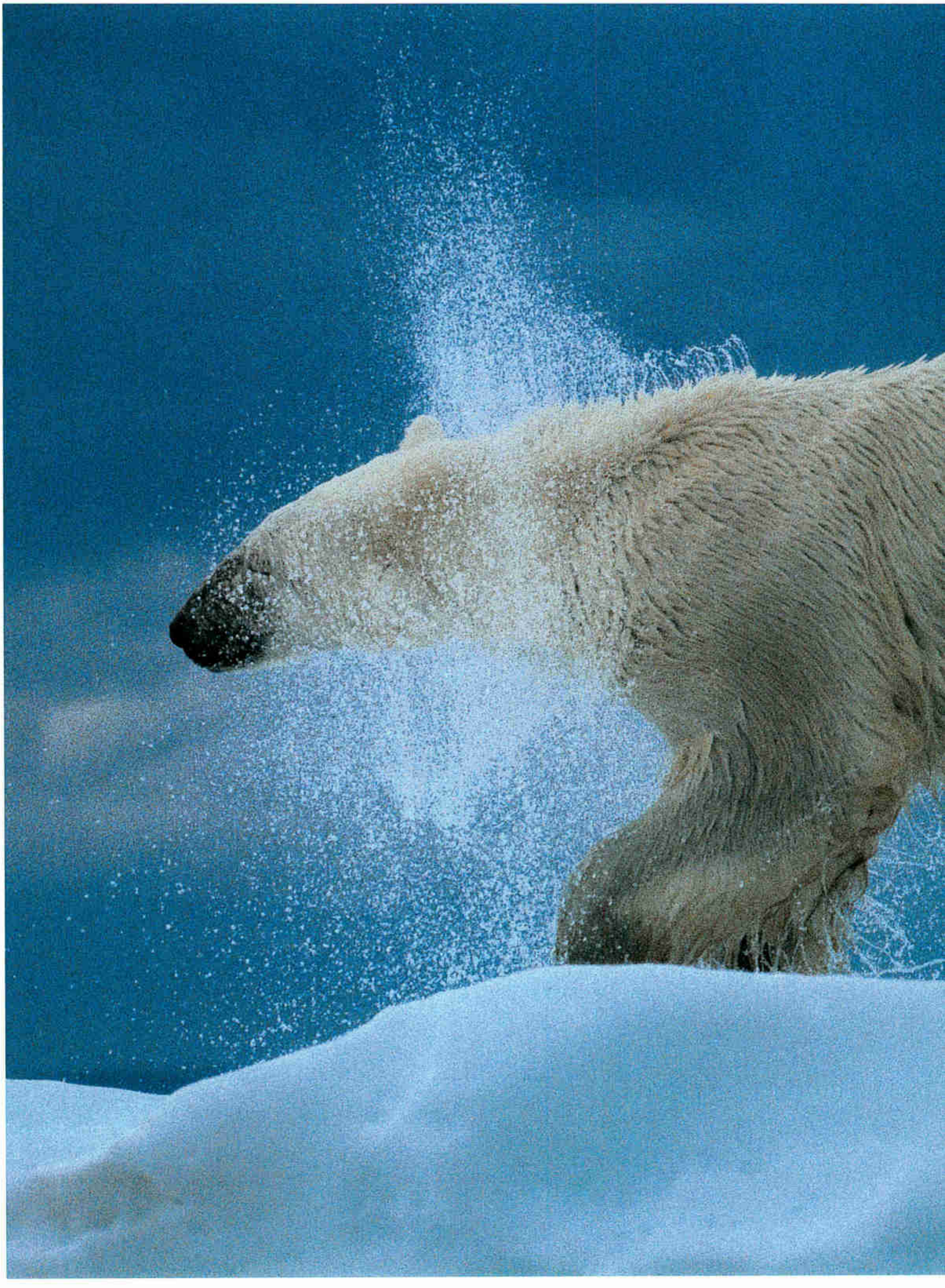


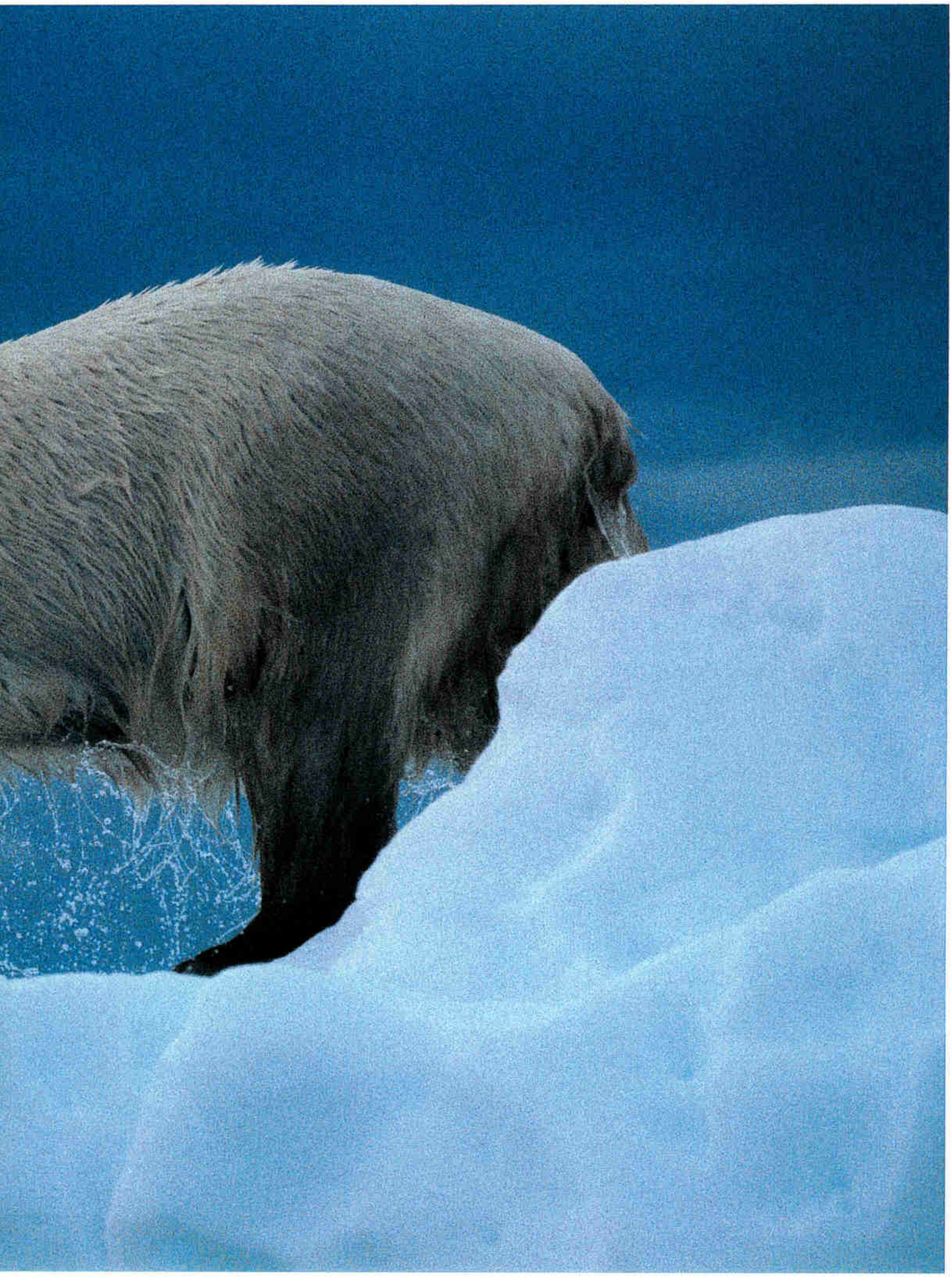
NO SAFE HIDEOUT The bears' favorite prey, ringed seal pups are born in spring in little caves that their mothers hollow from snowdrifts above their breathing holes in the sea ice. The pups seem well hidden—but not from the bears' incredible sense of smell. In Lancaster Sound one hunter follows its nose to a den (left), seizes a pup (below), and kills it with bites to the head. By six weeks old, the pups have become 50-pound butterballs that are almost half fat. Bears often ignore meat on the carcasses of adults, gorging only on the fat for pure energy.



ALL BY GLENN WILLIAMS







SUMMER FLING In July a bear shakes off after a swim in Canada's Wager Bay, a finger of Hudson Bay. Here and elsewhere in the bears' southern range, sea ice melts in summer. Without ice for a platform they cannot hunt seals, their main prey—and so they fast, eating almost nothing until ice forms in autumn.

THE GREAT BEARS lay sprawled on the sea ice, white on white. Only their black noses and eyes stood out. It was late May, mating season. For days this male and female had been traveling together over Barrow Strait and similar frozen channels in the labyrinthine Queen Elizabeth Islands of northern Canada. Other polar bears were hunting seals, but this pair probably weren't feeding. They had an appetite only for each other.

Flying in from a research station at Resolute on Cornwallis Island, the helicopter shattered their solitude. As it swooped low and made several passes over the fleeing bears, a .32-gauge rifle poked out and fired twice, sending a tranquilizer dart into each bear's shoulder.

Nothing like seven cubic centimeters of Telazol to ruin romance. In two minutes both bears were out cold. Their captors, Malcolm Ramsay and Sean Farley, got out their tools and went to work.

Malcolm has been collecting data on polar bears since 1980. His work, along with that of his colleagues, is offering new insights into how polar bears have adapted to their rigorous environment, how far they roam over its icy expanse, how they survive long periods without food. He also tracks a continuing threat to both the bears and the Arctic—toxic pollutants.

For two and a half hours the scientists collected blood and fat samples, extracted a vestigial tooth to determine the bears' ages, attached ear tags, and recorded the bears' temperature, length, girth, and weight.

Suspended from a large aluminum tripod, the six-foot-eight-inch female tipped the scale at 368 pounds. She was probably about five years of age. The seven-and-a-half-foot-long male, perhaps twelve years old, weighed in at 796 pounds. Some males can be more than twice as heavy—polar bears are often called the world's largest land carnivores. I kept staring at the head, a massive triangular wedge that looked as if it could smash through solid rock. It was more than 16 inches long and nearly a foot across. The paws, 8.5 inches wide, are used as flippers when swimming or as clubs to batter unwary seals when hunting.

"Sometimes I have a fantasy that the bear will suddenly wake and stand up," Malcolm said. "That happened to my students once. It was pretty exciting because they couldn't dart it again—a second dose might have killed it. They got out of range while it was still groggy."

On this perfect Arctic day—cloudless, miraculously windless, above freezing—we peeled off unneeded clothes and baked in the sun. Two ivory gulls soared overhead. In his well-worn red jumpsuit (easy to find in a whiteout), with his hair and beard a curly tempest of black and silver, Malcolm looked as though he had just hiked south from the Pole, having been flayed by the elements and loving every minute of it.

Besides teaching zoology at the University of Saskatchewan, Malcolm measures polar bears every spring, summer, and fall. He now has data on more than 2,000 bears he has captured or recaptured. Sean, a United States government research physiologist, had teamed up with Malcolm to try to determine how many seals a polar bear must eat to survive.

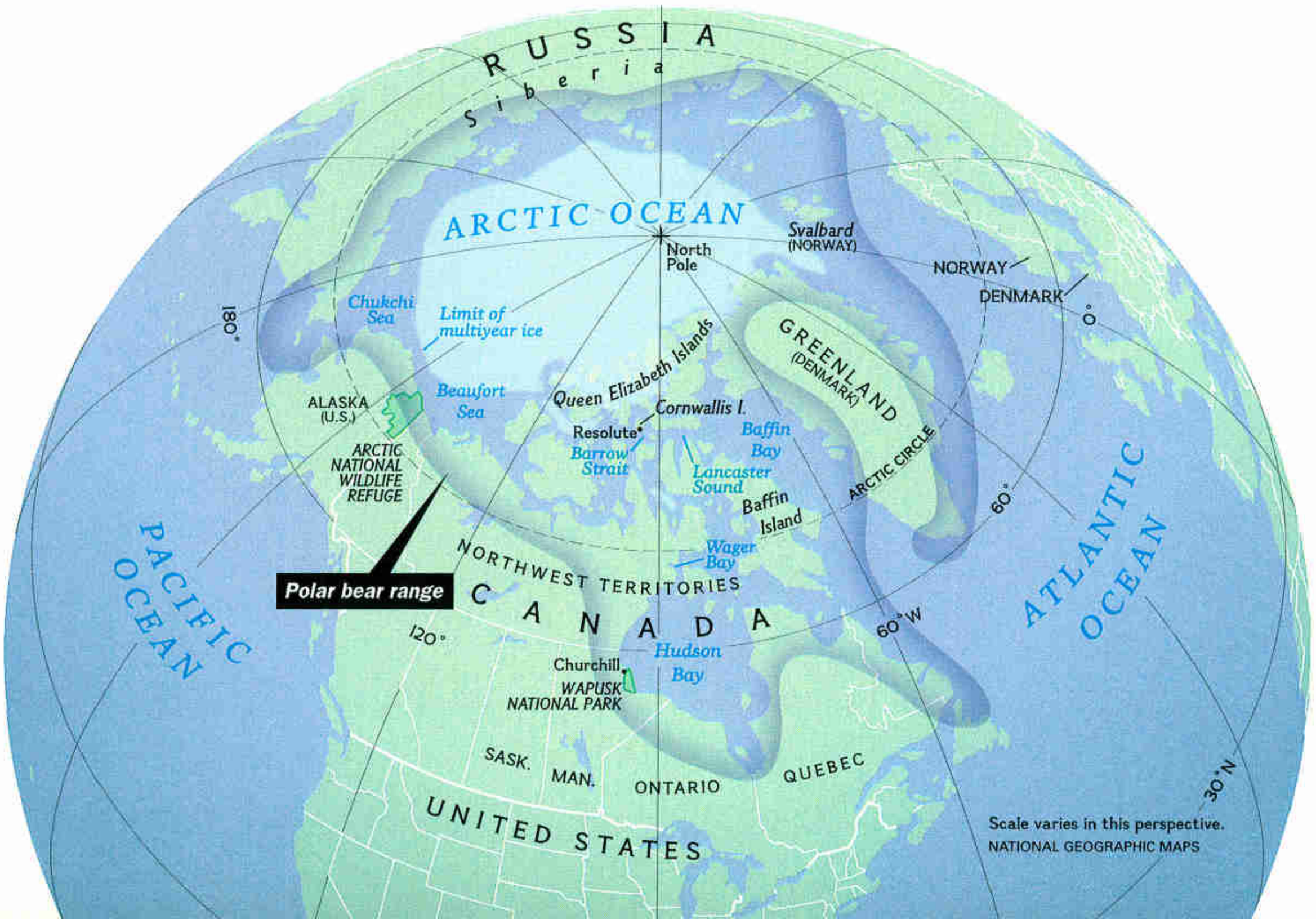
These two are part of a small community of scientists around the top of the world who have the will—and the funding—to work with a species that roams across so much territory. A female on which Malcolm put a radio collar one winter wandered over 30,000 square miles, the area of Indiana. It costs $2,000 a year to track just one polar bear. "We have no idea where the males go in winter," he lamented. "Standard radio collars won't stay on their necks, and the batteries in smaller ear transmitters last only a month."

For centuries the indigenous Inuit, who still hunt polar bears for their pelts, have called them *nanuk,* a word used with respect. Eighteenth-century European scientists named them *Ursus maritimus,* meaning "sea bear," and that they truly are, spending most of their lives on sea ice. (Little is known about how long polar bears live. Few carcasses have been found; the oldest was 32 years of age.) Polar bears can swim 100 miles at a stretch. But most females return to the land to den and give birth—and therein lies a clue to their past.

From an evolutionary standpoint polar bears are quite new. The first animals that taxonomists recognize as bears go back about 20 million years to the Miocene epoch. The size of a small dog, those early bears gradually grew much larger and began living in caves; some

FLIP NICKLIN, a veteran of more than 5,000 dives, has photographed whales, dolphins, seals, and other marine mammals for NATIONAL GEOGRAPHIC.

BRING 'EM BACK ALIVE Visitors bag a film trophy in Wager Bay. When native Inuit opened a lodge here in 1987, they decided to cater to ecotourists rather than to hunters. A Northwest Territories Inuit may charge $15,000 or more for guiding a sport hunter to a bear. Under a quota system about 500 of Canada's 15,000 polar bears are shot annually; Alaska natives take some 100 a year. The hunts are regulated by a 1973 agreement that also includes Greenland, Norway, and Russia. Since 25,000 to 40,000 bears range the Arctic, they are not classed as endangered.





were even bigger than present-day bears. They spread to all the continents except Australia and Antarctica. Some 200,000 years ago, when glaciers covered much of Eurasia and the Arctic Ocean was frozen, hungry brown bears wandering frigid northern shores discovered something new to eat: seals.

At first those bears probably just scavenged seal carcasses that washed ashore. Then they began to catch live seals by sitting quietly on the ice and waiting for the seals to surface at their breathing holes. Here was an untapped ecological niche. By 125,000 years ago, a new species had appeared in Eurasia, split off from its brown bear ancestors. Gradually its head and snout had grown longer, and its teeth had become smaller and more jagged—a better design for tearing seals apart. Its coat turned white, blending with the surroundings. Those white bears began to walk great distances to hunt seals until, possibly within a few thousand years, they ranged across the Arctic.

Today between 25,000 and 40,000 polar bears roam this frozen world. They aren't considered endangered, thanks to international foresight. During the 1960s concern about overhunting grew among the five nations with polar bears—Norway, Canada, the U.S., Denmark (for Greenland), and the Soviet Union. Norway outlawed hunting of its bears, Canada began research that led to a quota system, and the U.S. passed the Marine Mammal Protection Act, which allows only Alaska natives to take polar bears. Greenland's Inuit continue to hunt 100 to 150 bears a year for subsistence. In 1973 the five countries signed the International Agreement on Polar Bear Conservation, the first joint compact on the animals.

The overhunting that was rampant before the agreement has been significantly reduced or eliminated, so populations remain fairly stable. In addition Canada and Norway have created national reserves specifically to protect polar bear habitat and denning areas.

In the Soviet Union polar bear hunting was banned in 1955. But today, in the wake of Russia's free-market economy, some Russian researchers fear increased poaching of the polar bears that range over the Chukchi Sea between Alaska and Siberia. They also worry about the long-term effects of recent oil spills into Siberian rivers that flow into the Arctic Ocean.

In Alaska the oil and gas industry, conservationists, and the federal government have long butted heads over proposed drilling on the northern coastal plain of the Arctic National Wildlife Refuge, denning area for many of the Beaufort Sea's 1,800 polar bears. How much would oil and gas exploration disturb them? No one knows.





Alaska natives now harvest about 100 bears a year for subsistence. Some 500 of Canada's 15,000 bears are shot annually. Canadian Inuit may hunt bears with permits issued to their villages; they usually sell the hides, which go for $1,000 to $3,000 each. Inuit in the Northwest Territories may also offer their permits to nonnative sport hunters, who pay $20,000 for the chance to spend ten grueling days with an Inuit guide hoping to bag a bear.

MALCOLM RAMSAY is tracking a presence that could prove far more threatening than hunting, not just to the bears but to most living things in the Arctic. Since 1968 researchers have detected toxic contaminants in the tissues of polar bears.

"We're finding organochlorines like PCBs, dioxins, and DDT in the bears' fat and milk," he said. "They're coming from Asia, Europe, and North America.

"The Arctic Ocean might be a natural sink for contaminants. They're picked up by marine organisms like amphipods, which are eaten by arctic cod, which are eaten by seals. By the time the bears eat the seals, concentrations have increased a billionfold. We're now trying to see what impact this has on the animals."

Such concerns extend to the human community. "Because of contaminants, Inuit

HANDS-ON SCIENCE In Canada's high Arctic ecologist Malcolm Ramsay creeps toward a sedated female. When he and the cubs reached her side, he sprayed tranquilizer into their mouths. Sean Farley bags a cub to weigh it. Ramsay extracts a small tooth to gauge an adult's age. He also monitors pollutants passed up the food chain and concentrated in the bears' fat.



women don't breast-feed as much as they once did," Malcolm said. Women tested in the Canadian Arctic had about six times the amount of PCBs in their breast milk that women in urban areas of Quebec Province did.

Malcolm tests bears twice each spring. Born around New Year's Day, cubs leave the den with their mother in late April, when she begins to hunt seals. Malcolm captures as many of those family groups as he can and measures their blood, milk, and fat for contaminants, which should be low because the females have been fasting for eight months. After the females have gorged for a month, he recaptures as many as possible to see the hidden cost of all those seal dinners. When he tested a dozen bears in April and then again in May 1996, levels of DDT, PCBs, and chlordane had increased between 12 and 34 percent.

How many seals does a polar bear eat in a week? In a year? No one knows. Malcolm hopes to find out by attaching a collar fitted with a small video camera. The camera would transmit images by radio signals. He should then have a record of a bear's weekly menu, as well as a bear's-eye view of the final kill.

Polar bears use two strategies to hunt seals: stalking and ambush. Seals are wary, so they usually haul out of the water near their breathing holes in the ice. If it sees or smells a seal on the horizon, the bear slowly stalks the seal, then breaks into a charge. Sometimes the seal escapes down its hole, sometimes it doesn't.

In summer a bear might hunt by swimming under the ice, which is rapidly breaking up. From the surface it spies a distant seal lying by its breathing hole, then dives through a nearby opening and swims underwater toward the seal, surfacing at other holes along the way to breathe and to calculate distance and direction to its target. Finally the bear reaches the seal's hole and explodes through it from underneath.

But a bear's main strategy is ambush. Lying on its chest and stomach with its nose near the seal's breathing hole, it keeps absolutely still until the seal surfaces to breathe. Then the bear quickly delivers a fatal series of bites to the seal's head.

How can these immense mammals stuff themselves, then fast for months? Polar bear metabolism has long been a hot field of study. The best place to see this metabolism in action—and inaction—is on the western shore of Hudson Bay, a thousand miles south of the Queen Elizabeth Islands.

MIKE HARRISON HAD A PROBLEM. His engine temperature had risen ominously to 200°F. The vehicle he was driving—one of ten Tundra Buggies, which resemble moon rovers—was slogging through the snowy mush around Hudson Bay in late October. Mike radioed the other buggies.

"A bear got tasty with my radiator hose. Anybody got any antifreeze?" he asked. A curious bear named LD had been checking out our buggy's underside—drawn by leaking fluids, to judge by our need for a refill.

"Sure, we've got Evian. Nothing but the best," another driver replied, as he came to our rescue.

Mike's passengers included 11 ecotourists and two scientists as guides: Malcolm Ramsay and Jane Waterman, a behavioral ecologist at York University in Ontario. This was Malcolm's one-week sabbatical from helicopters.

We were riding through the world's densest population of polar bears, about 1,200 in a narrow swath along the western shore. For several days the temperature hovered stubbornly just above freezing. Around stunted black spruce and willow shrubs, snow dissolved into the tundra. Nothing stirred but the bears. Although some were still sleeping in the snow, others were restless, and several pairs of young males had begun to spar.

The buggies maneuvered for the best bear-watching angles, but the bears, long habituated to humans, seemed unperturbed. Thousands of ecotourists come to this strip of land each fall to watch bears. The visitors arrive at Churchill, the Polar Bear Capital of the World. For years Churchill was also infamous for its garbage dump, which attracted bears by the dozen; many were shot. The dump still operates but sans bears, for it is ringed with traps and patrolled day and night.

In summer and fall people and bears run into each other almost daily in or near town. That's because of the bears' life cycle. "Most spend winter and spring on Hudson Bay," said Jane. "They hunt seals mainly during the spring, until the ice breaks up. When it melts in early summer, the bears come ashore. For months there's almost nothing to eat, so they sleep and wander around. They're fasting—

NORBERT ROSING

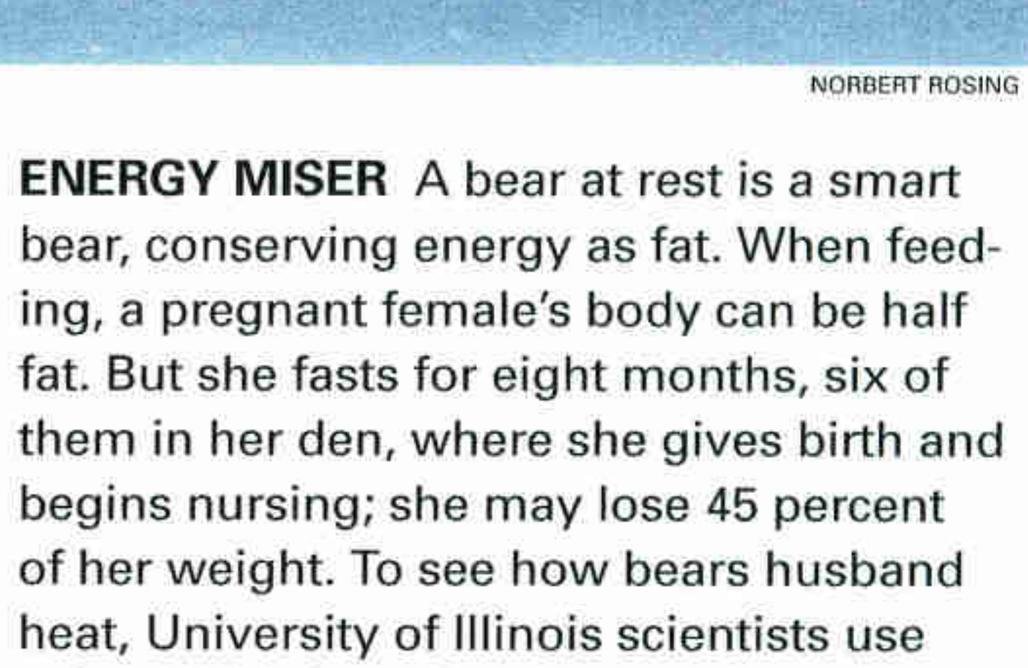
it's sometimes called walking hibernation."

They also walk right into trouble when they come too near Churchill. Provincial officials sometimes put repeat offenders to death, but they "arrest" most problem bears, then "jail" them in a converted warehouse that can hold 23 inmates.

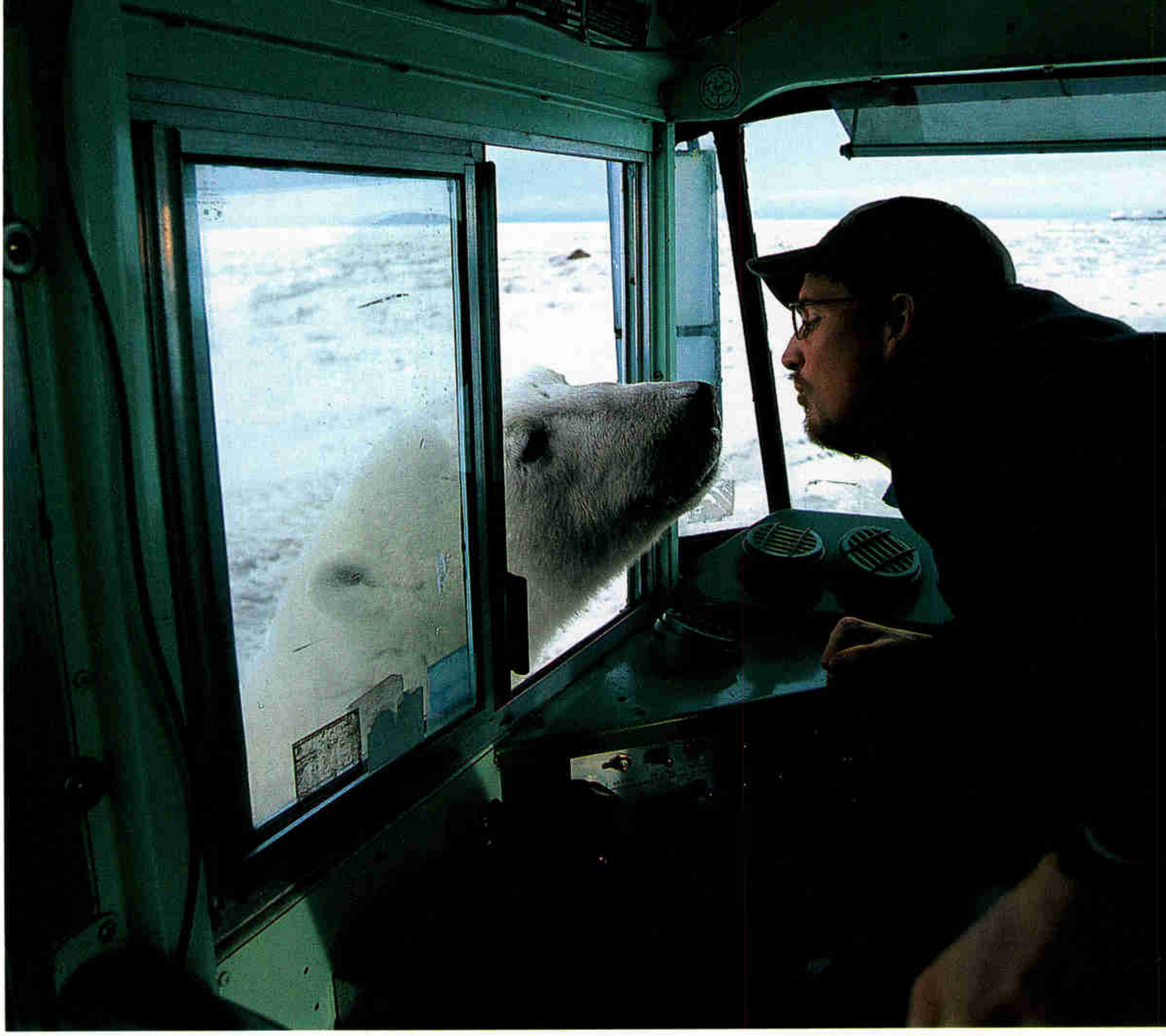
There they are given water, but no food. The deprivation sounds cruel, but Jane and Malcolm point out that there's little difference between a confined bear that isn't fed and a bear fasting naturally. The captives are released north of town after about a month. The freed bears join the wild ones on shore, waiting for ice to form on the bay—a frozen bridge to the seals. The circle is complete.

How adaptable are bears to this feast-or-fast cycle? Their tolerance could already be under strain. A few years ago the Canadian Wildlife Service reported that since the early 1980s the weight of adult female bears at Hudson Bay has declined, as has the survival rate of their cubs. Much of this information comes from Ian

ENERGY MISER A bear at rest is a smart bear, conserving energy as fat. When feeding, a pregnant female's body can be half fat. But she fasts for eight months, six of them in her den, where she gives birth and begins nursing; she may lose 45 percent of her weight. To see how bears husband heat, University of Illinois scientists use enhanced infrared imagery. Yellow and red areas are hottest, blue and violet coolest.



RALPH NELSON AND JONATHAN EK, CARLE FOUNDATION



Stirling, a veteran polar bear researcher with the service. He wonders if climate change—including global warming, if that trend is confirmed—could be among the factors responsible.

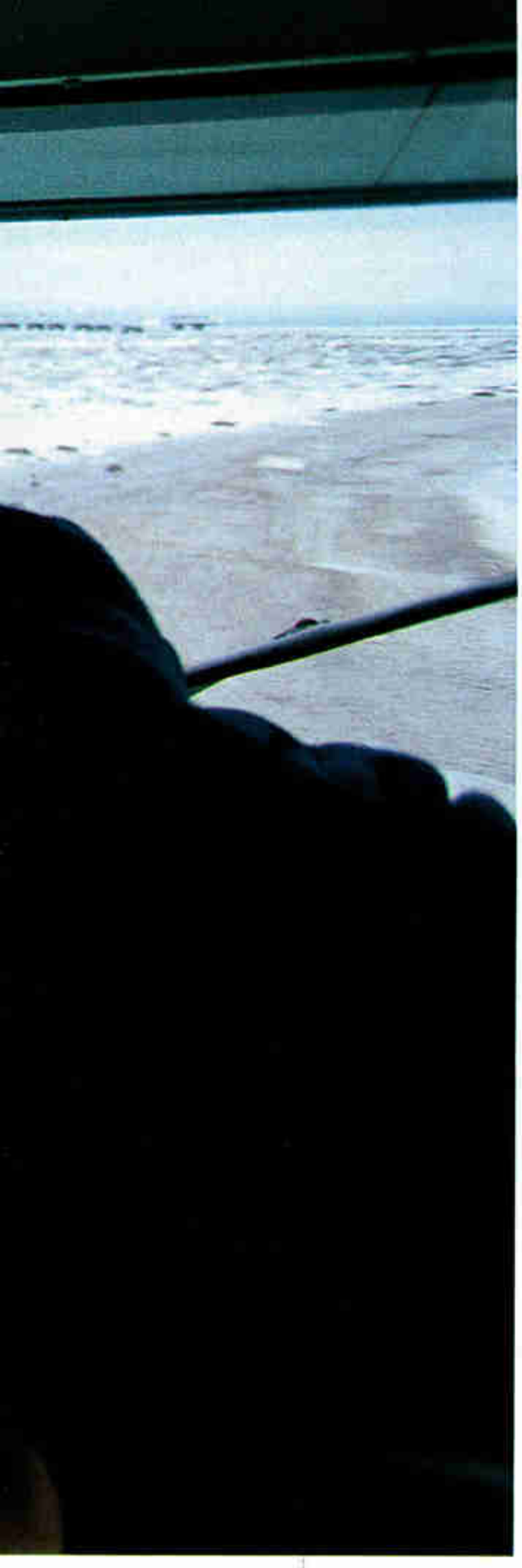
Malcolm Ramsay says data for the bears he has captured don't completely agree with Stirling's. But Malcolm does agree that if global warming is affecting the Hudson Bay bears, whose numbers have remained stable for at least two decades, the consequences will be dire. If the ice melts sooner in spring and refreezes later in fall, the bears will no longer feast. They will fast until they starve.

While gorging on seals from April until early July, impregnated females can increase their body fat to 50 percent or more. They build up a five-inch-thick layer of fat around the thighs and rump. This isn't so much for insulation, Malcolm thinks, as to provide calories to keep their engine going when food is scarce.

Polar bears are masters at conserving energy. During their eight-month fast, breeding females can lose as much as 45 percent of their weight. So heat retention is important, to avoid spending too much energy to keep warm. The bears' fur is dense, made of clear hairs that scatter light, creating a white effect. Strip the fur away, and you'll find black skin that absorbs the sun's rays. The long snout contains large membranes that warm and moisten the dry, frigid air before it reaches the lungs.

To demonstrate how polar bears expend energy, Jon Ek, a medical researcher at the University of Illinois, hauled an infrared imaging system aboard our Tundra Buggy one day. Jon's mentor at the university is Ralph Nelson, who for decades has studied bear metabolism in hopes of finding applications that could alleviate dietary, bone, and kidney disorders in humans.

When Ralph and Malcolm worked together years ago, they had to sedate bears in order to take samples for laboratory analysis. "That's





TEMPTING FATE More than 5,000 visitors a year ride outsize vehicles called Tundra Buggies to see the famed Hudson Bay polar bears near Churchill. All are admonished by guides to keep a healthy distance from curious bears that approach their buggies. In this case only photographer Nicklin was a passenger. In 1983 a tourist from Milwaukee was severely mauled when a bear nearly pulled him through an open window.

Habituated to buggies and their excited cargo, bears hang around a vehicle camp (below) where tourists stay for a week. Some bears—like these two nosing around under a buggy—have a taste for antifreeze that could prove fatal.





the great thing about this infrared imagery—it's noninvasive," Jon said. He and Malcolm simply aimed the infrared apparatus at nearby bears. In the viewing screen a gray scale represented different intensities of heat radiating from the bears' bodies—white for the hottest, dark gray for the coolest. The faces and forelegs, with little fat, showed as white; well-insulated haunches came out dark. Jon later imaged a bear's paw print and watched the heat still radiating from the snow five minutes after the bear had walked away.

Jon and Malcolm also imaged male bears doing what they are renowned for doing in October: play-fighting. The researchers hope to learn how much energy such roughhousing costs animals with a carefully balanced calorie budget. The bears were shaking off their summer lethargy as autumn unfolded. Several pairs squared off, and we had a ringside seat for a bout between two combatants that Jane had named Hook and Scarface.

They faced off nose-to-nose, mouths open, then reared up and wrestled with their front legs wrapped around each other. They pummeled hard with their paws but did not draw blood with their claws. Finally one of them lay submissively on his back, punching the bear above with his front paws while his rear legs gyrated wildly. After 15 minutes they called time-out.

"Polar bears are often said to be asocial, but that certainly isn't the case right now," said Jane. "Usually only males play-fight, and they



MOCK HEROICS Young males play-fight on the Hudson Bay shore in a harmless autumn prelude to spring battles for mates that can end in shattered limbs. Lethargic all summer, males may benefit from such exercise and also learn to assess other bears' strength. When shore ice forms in mid-November, most bears move out to winter on the bay.

don't do it in summer, when they're much more spread out along the coast. But now they're coming together as the ice forms, so it's a time to be social."

Why do they spar? After hanging around all summer losing weight and muscle tone, the males may benefit from the exercise. They may also learn to assess their opponents' strength and establish dominance. And such skirmishes may be a tune-up for truly violent battles when males compete for females in the spring.

While males and nonbreeding females wait for freeze-up on this inland sea, pregnant females prepare to stay ashore. Most have already dug into the earth, creating the dens where they'll give birth, sheltered from the gales of December.

PALE SUNLIGHT FILTERED through smoky clouds as our helicopter lifted off from near the Tundra Buggy depot. From the air I counted 40 bears on the shore below, one of them eating kelp that had washed ashore. At Watson Point we crossed the boundary of 4,500-square-mile Wapusk National Park, created in 1996 partly to safeguard the most concentrated collection of polar bear dens in the world.

After we set down near a snow-covered meadow, Malcolm walked over to a hole about three feet wide. Below lay a vacant, tunnel-like chamber three feet high and seven feet long that a bear had dug for her den long ago.

"This huge denning area, which begins just a little inland from Hudson Bay, covers more than a thousand square miles. There are hundreds of dens. Bears have been using them for centuries," Malcolm said. "Most of the area is peat bog. Peat dries quickly and makes great insulation. The females orient the dens so they face south and east, away from the prevailing wind."

A few miles away, Malcolm said, females already occupied other dens. They had mated last spring, but their fertilized eggs didn't begin to grow right away—a strategy called delayed implantation. That lets the females fatten up on seals in spring before the demands of pregnancy begin. The mothers-to-be need to put on well over 400 pounds of fat to sustain themselves and their cubs.

Embryos start developing in fall, and the mothers give birth in December or early January. In the den a female's heartbeat slows from perhaps 60 beats a minute during normal sleep to less than 30 beats. Unlike black bears and brown bears, in which both sexes spend the winter in dens, only pregnant female polar bears do so. Males and nonbreeding females may build temporary snow shelters during fierce Arctic storms, but





MICHIO HOSHINO, MINDEN PICTURES

OUTFOXED Crouched near a potential meal ticket, an arctic fox will get no scraps from this sleepy bear, fasting and waiting for Hudson Bay shore ice to form. Unlike brown bears, polar bears do not bury partly eaten carcasses but leave them on sea ice to be scavenged by foxes, ravens, and other bears.

otherwise they just keep moving all winter.

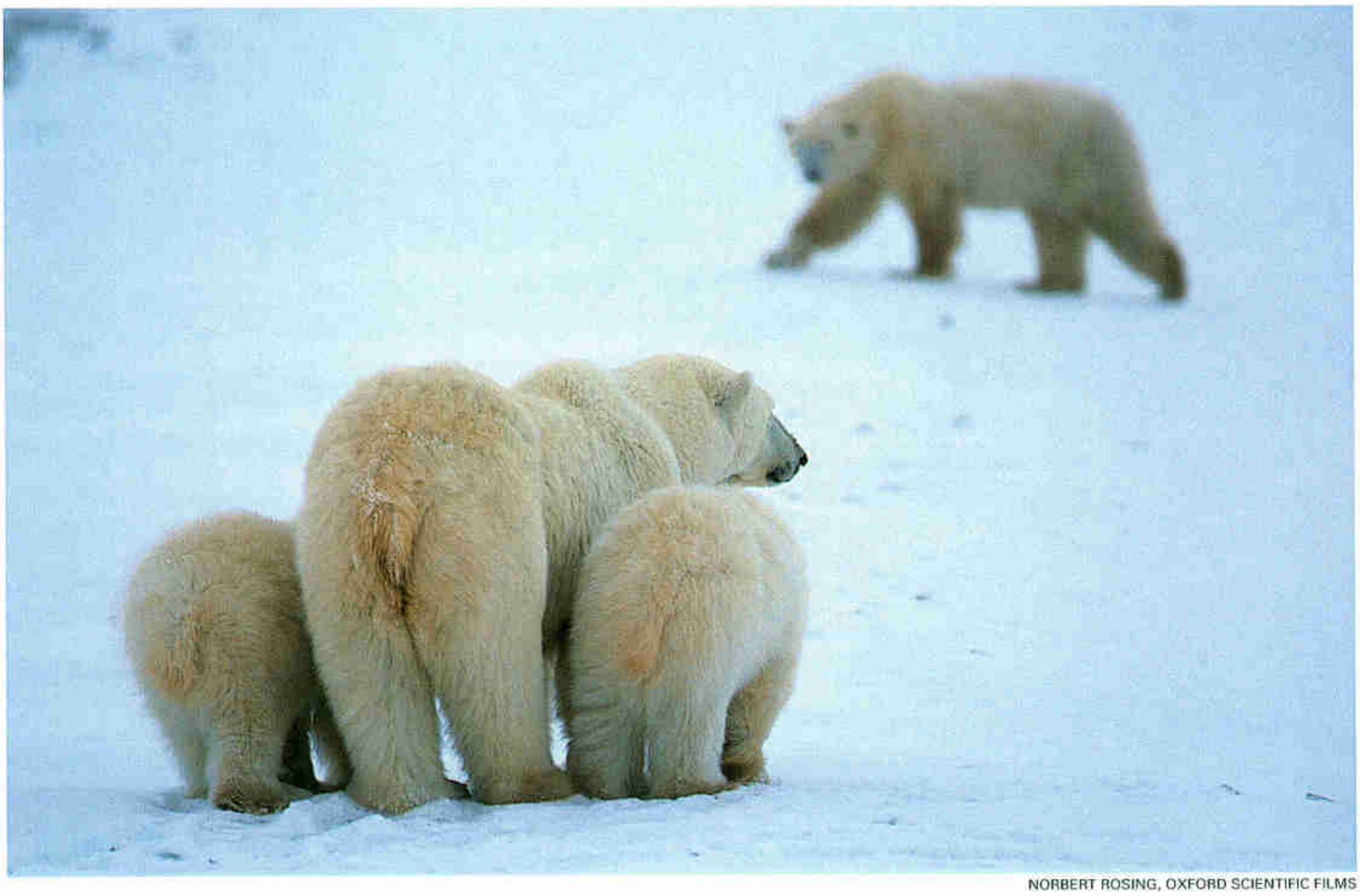
While most females deliver twins, triplets aren't uncommon at Hudson Bay. At birth the cubs weigh little more than a pound, with hair so fine it's nearly invisible.

Mothers nurse the cubs with milk richer than that of any other bear. To replenish their depleted reserves, the females, still nursing, leave the den with their 30-pound cubs in March or April, when hundreds of seal pups are being born, and start hunting.

Most females keep their young with them for two and a half years, but many Hudson Bay mothers wean their cubs a year earlier. That allows them to breed every two years instead of the usual three. Perhaps the large number of seals at Hudson Bay influences this fecundity. The abundance of seal carcasses left on the ice might make it possible for young bears to scavenge at an earlier age and become independent sooner.

But other factors may be involved. Malcolm emphasizes that what he doesn't know about polar bears far outweighs what he does know. New technology will play a part in future studies. Small electronic transmitters, which have all but replaced the old seven-pound radio collars, will track the bears longer and farther. Perhaps Malcolm's video camera idea will allow bears to film documentaries of their own journeys. His colleagues continue to study the bears' diet, metabolism, and energy-conserving adaptations.

Now, in the dim light of January, the Hudson Bay males and nonpregnant females are far out on a sea of ice bigger than Texas, white on white, invisible to scientists. Some bears emit radio signals that give their location—but what are they doing? Are they hunting? Are they fasting? When July comes, the ice will melt and the bears will come ashore, where the scientists will be waiting for them. □



NORBERT ROSING, OXFORD SCIENTIFIC FILMS

TOUGH LOVE A lone male warily eyes a female guarding her young. Given a chance, males may kill and eat cubs. After spring mating, fertilized eggs do not begin to develop until fall. Thus a female delays giving birth until midwinter. She emerges with her cubs in spring, when she can hunt newborn seals to replenish her fat reserves. For about two and a half years mothers nurse their cubs (right) with milk containing 35 percent fat—a security blanket for the Arctic winter.



A SPECIAL PLACE

Daylight breaks over the tidal reaches of Georgia's Altamaha, waking Southerners to a river many consider close to perfect: It's full of fish, drips with history, and, as a local shrimper says, "There's a lot of peace out there."

The Easy Ways of the Altamaha

By REG MURPHY
PRESIDENT, NATIONAL GEOGRAPHIC SOCIETY

Photographs by PETER ESSICK





Deep in a backwater slough, bald cypresses rise from a bed of water lilies. In the green gloom, sounds startle: the croak of an egret, a sudden splash—turtle? alligator? The Altamaha's soggy floodplain discourages most development from taking root.



As a child, I waded knee-deep in swift-running Blue Ridge mountain streams and wondered where the water went. As a young political reporter, I got the dust of south Georgia river communities on my shoes without understanding the significance of the water. And as a somewhat more contemplative part-time resident of coastal Georgia, I have come to live near the river almost nobody knows.

The Altamaha pumps 100,000 gallons of fresh water into the Atlantic Ocean *every second*, more than three trillion gallons annually. Its watershed, the third largest on the East Coast, shelters more than 125 rare species of flora and fauna. But it gets scant respect.

Even when the coastal Georgia natives know the rich lore of these riverbanks, they'll tell you, "This place ain't good for nothin' but to hold the world together."

That is the way of self-deprecating Southerners—to make light of what they love most. For it is clear that the people who live along the Altamaha treasure their river. They name everything from bait shops to banks after it. They take their pleasure on it and count their seasons by it. Sustenance comes from it, and poetry is written about it. And for some of us, it stirs the imagination.

It takes all of my imagination to conjure up the pictures that capture its rich history: Guale Indians roasting salty oysters in their shells. The Spanish, bent on converting the natives, building missions along the coast. British troops establishing a sturdy cypress fort to keep the Spanish and French from occupying the rich timberlands. Scottish Highlanders settling the high ground along the banks. The coming of the first naturalists to tour the area, John and William Bartram, wonder-eyed at "scenes of grandeur and sublimity." And the river, endlessly resisting the loggers, polluters, squatters, and despoilers until it is dreamland for those who know it best.

Al Brown knows the river about as well as anyone. When he isn't dealing real estate, he is on the river or dreaming about being there. On a crisp, cloudless morning he prepares to put *Big Red*, his sparkly bass boat, into the river at Two Way Fish Camp. "Almost nobody around here knows much about the river," he says. Then he cranks the 150-horsepower motor, and we are off on a rediscovery.

There is much to discover about the Altamaha, but it is discovered best if one relaxes and dreams. There is no beginning in the classic sense, no headwaters. It forms 137 meandering miles from the Atlantic Ocean where the Ocmulgee and Oconee Rivers bang into each other.

Big Red cuts under the Interstate 95 bridge and takes its passengers to a world that is tranquil enough for a visitor to play peekaboo with a pileated woodpecker hiding in a pine tree and scary enough to include a backwater called Alligator Congress. Could a Guale hunter have seen that woodpecker's ancestors before the Europeans came? Probably, the naturalists think. The hunter most certainly would have seen bald eagles where we count ourselves lucky to spot a couple of eagle aeries.

Brown edges us gently by Couper Bar, a giant sandbar. Low tide

Peter Essick, a regular contributor to National Geographic, lives in Brooklyn, New York.



A shrimp boat slips out of Darien, first and last town on the river. These days the town's 30 boats chase a declining catch of the crustaceans; winter shad fishing supplements the watermen's income. Ocean bound, the vessels thread marshes where shrimp are nourished before their own passage to the sea.

approaches, and soon the yellow sands will show through the silt-laden river water. This is the bar that at low tide blocked the passage of huge rafts of timber a century ago. The trees felled upriver used to float down to the Atlantic, where they were processed into logs and shipped to the rest of the world.

Through a swirling series of creeks and man-made cuts through the golden marsh grass, we discover again the true might of the Altamaha. Frustrated by the low-tide delays at Couper Bar, planters and businessmen combined to create Rifle Cut in the 1820s.

The cut is a mile-long ditch plunging directly through the forested floodplain at a swirly curve in the river. The theory was that the Altamaha would choose to charge straight ahead to Darien, washing a wider passageway through the cut and abandoning four to five miles of curves and sandbars. Never happened. Rifle Cut still barely accommodates the boats coming downriver, while the main channel of the river sweeps in unperturbed majesty through its chosen course.

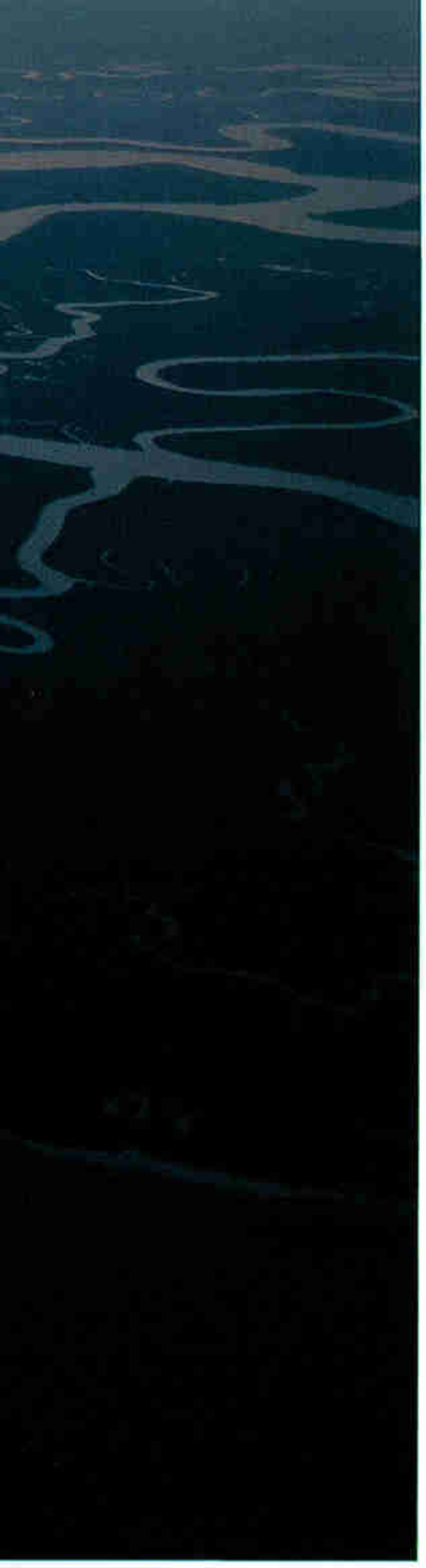


A flare of dying light blazes a trail through intricacies of salt marsh near the river's mouth at Wolf Island, at right. The first European explorers—16th-century Spanish gold seekers—followed the water path inland to search for the Indian village of Tama, the root of the Altamaha's chantable name.

BROWN STEERS *Big Red* into Little Buzzard Creek, where somebody tells the story of a duck hunter who was standing in one of these marshes. He felt a tug on his hip wader. Looking to see what he was snagged on, he saw a big water moccasin with its fangs hooked onto his rubber boot. It was said that he did a marvelous arabesque trying to get his gun into position before bashing the snake away. (How big was the snake? "You don't measure a snake till it's dead.")

Sometimes, Al Brown said, you go into these swamps and see six to eight alligators at a time. "There are more gators than snakes," he adds. "I was camping out a few years ago, and I went down to the river to bathe. I had my head underwater when I remembered that gators feed at night. I hurried the procedure."

Why would anybody love this snake-infested, gator-dwelling stretch of muddy river? Well, you might as well ask a Southerner why he or she likes grits. Because, dadgummit, it is a part of what we are. Not some



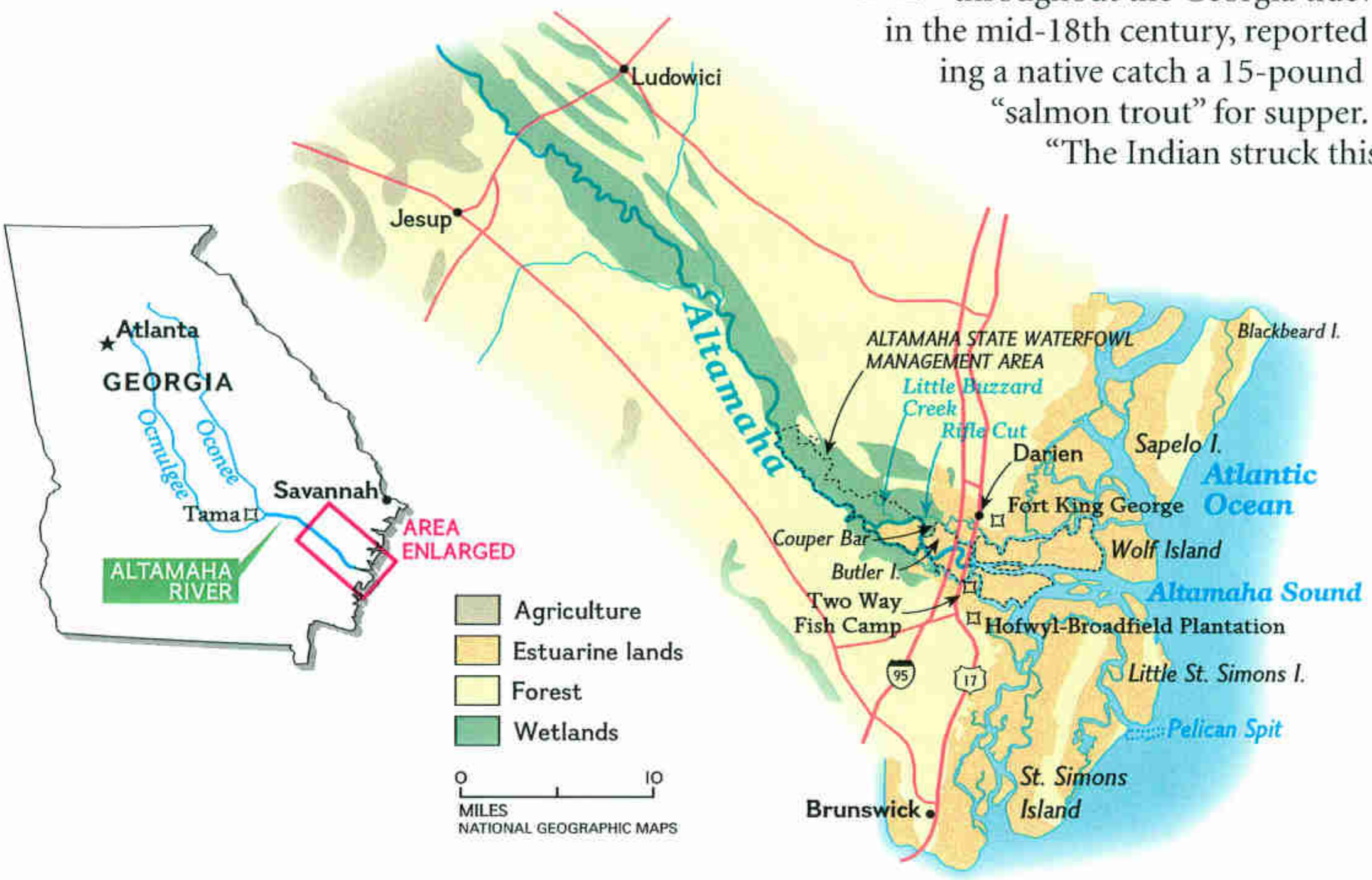
phony columned mansion dolled up like an imaginary Tara. The Altamaha is the Real South.

Just before sundown, as dusk comes toward the marshes, the waist-high grass relinquishes its chlorophyll tint and takes on the glow of gold. A gentle breeze waves through it. Down at Fort King George, I stand on a little dock extending out into the marsh. A snowy white egret drifts down into the stream winding through the grass. The eternal quest for food—for life itself—plays out all day and all night in these places. I love to stand here thinking about what is within 50 paces, gentle animals and mortal enemies both.

William Jones III ("Young Bill," we call him) tells of tromping *barefoot* across these marshes. I both believe him and am thankful that he survived to become one of the most important businessmen and one of the best outdoorsmen in the area. Much as I love the river and its estuaries, much as I like the feel of the sand underfoot when the river reaches the Atlantic, I will never be inclined to walk unshod in the thick black mud of the marshes.

The Altamaha challenges the imagination. The Guale (pronounced wally) lived here first. To visit the great estuary is to question how they lived here at all, given the clouds of mosquitoes, the snakes, and the sweltering summertime heat. But they persevered. "The tidal streams and marshes provided a limitless supply of seafood," Buddy Sullivan wrote in *Early Days on the Georgia Tidewater.* "Deer proliferated [in] the forests and savannas. . . . The Guale women, with their shell hoes, cultivated the land, growing corn . . . pumpkins and squash."

THE MEN must have been great fishermen. William Bartram, who with his father, John, traveled throughout the Georgia tidewater in the mid-18th century, reported seeing a native catch a 15-pound "salmon trout" for supper. "The Indian struck this







fish, with a reed harpoon, pointed very sharp, barbed, and hardened by the fire. The fish lay close under the steep bank, which the Indian discovered . . . ; instantly the fish darted off . . . whilst the Indian pursued, without extracting the harpoon, and with repeated thrusts drowned it, and then dragged it to shore."

The Guale's dominion ended with the arrival of those seeking land, wealth, and souls—Spanish friars, French from the Mississippi Valley, Gen. James Oglethorpe's British troops. The Guale massacred five Spanish priests and destroyed several of their missions, the mosquitoes doubtless provoked a mutiny or two, and the Altamaha rolled on. By 1721 the British had built a fort on the high land overlooking the river to defend their territory from French colonists.

Ah, yes, the high land at the mouth of the Altamaha. That would be Darien, Georgia, once a major banking and exporting center on the eastern seaboard and now a homey, chatty, easy town. As in most southern towns the courthouse is one of the most prominent buildings. The streets are quiet, the lawns neat, the atmosphere neighborly. The main street, Highway 17, runs down to the river past the Texaco station. It reaches the bridge where the shrimp-boat fleet glistens white

A shower of sunlight falls through a live oak on Sapelo Island, a plantation site during the Altamaha's 19th-century heyday. Union troops razed Darien in 1863, leaving little but a warehouse and a ruined wall of sand and oystershell (left) to recall when the port sent cotton, rice, and timber around the world.

against the black-brown river, heavy with farmland nutrients washed downstream.

In April, Darien stops whatever it has in mind and pays attention to the fleet. One by one the boats push under the Highway 17 bridge as thousands cheer. A Roman Catholic priest and his Episcopal counterpart stand on the bridge and sprinkle water onto perhaps two dozen of them. Then the onlookers retreat to the roadside craft stands to finger the merchandise or find barbecue for a Sunday afternoon picnic with the family.

WHEN JANUARY CHILLS THE ATLANTIC OCEAN and the shrimp move offshore, the shrimpers head for the Altamaha. It's time to spread their gossamer nets for the plentiful shad, fat with roe. Busy though they are, these watermen take time to chat with a sometime neighbor, one county removed.

I clambered into a narrow skiff with 21-year-old Darrell Gale, the

Lady Pamela, *a former beauty, ends up as a derelict among the spidery creeks off Little St. Simons Island. The old schooner sank at a nearby marina in 1992 and was hauled here to decay in the marsh.*



third generation of the Gale family to fish the rivers and the coast. He looked the way a young riverman is supposed to look, black hair disheveled, arms muscular from work, and quiet in his eyes. Pulling at the floats and boating the silvery shad, Gale insisted, "This river is not polluted. It's in pretty good shape. And the fishing's good." Hauling in 70 to 100 dollars' worth of fish a day, he is a youngster whose future would seem secure. But what he really would like to do is go to college. "I wanted to study marine biology," he says wistfully. Instead, he plans to acquire a shrimp boat of his own.

No college for his dad, Darwin Gale, after 31 years of pulling fish from the Altamaha and shrimp from the Atlantic. Darwin welcomed me onto his little motor skiff drifting with the tide a few hundred yards upriver from Darrell. The craft felt unsteady, but the waterman was as at home there as on land. When he had netted a dozen shad, I departed, and he took off upriver full throttle, standing, fully confident of his footing. "We lose somebody every year or two," said a woman who lives alongside the river.



Steve Smith drifted by, looking like a man ready to shout "free at last." "I got me a hill job six years ago when the shrimp were scarce," he said, using the waterman's phrase for nonfishing employment.

Smith welcomed me aboard. Soon two hungry brown pelicans floated alongside, begging. Smith leaned halfway out of his tiny craft to place a smallish shad in one pelican's beak. Despite its hunger, the other bird was wary. It clearly wanted the fisherman to toss the fish; Smith was adamant. He eventually won the standoff. Desire overcame reluctance, and the pelican swam close enough for Smith to place the fish in its big, sagging beak.

"That's generous of you," I said. "They're not worth hardly nothin'," he replied. "Maybe 40 to 50 cents apiece."

As the fishermen worked the river, it flowed easily if swiftly with the outgoing tide toward Altamaha Sound and the Atlantic. Unlike other streams nearby, there is virtually no floating debris here. Carolyn Hodges, its energetic guardian and a former president of the Lower Altamaha Historical Society, takes that as her personal challenge. We cruised the river for hours in her powerboat looking to collect three pieces of trash (cans, bottles, or plastic bags), which she vows to find and remove when she ventures out two or three times a week.

That is not to say that the Altamaha always has been pristine. Once 210 houseboats, many of them little more than homemade shacks floating on plastic drums, clung to the shore, dumping their waste into the water untreated. But by June 1997 the unsightly houseboats were mostly gone, banned under a new state law.

The pungent scent of marsh mud lifts from a prairie of spartina, first link in a rich food chain. Upend a plot of Georgia marsh, says writer John McPhee, and "anchovies would fall out, and crabs, menhaden, croakers, flounders, tonguefish, squid." A black-necked stilt (left) prefers bugs on the beach.

Perhaps such efforts to clean up the Altamaha will help bring back the Atlantic sturgeon, a victim of pollution and overfishing. Once these giants of the sea—up to a thousand pounds and perhaps 60 years old—came up the river by the score to spawn. In 1978 a local entrepreneur developed a thriving business: "Fresh quality caviar processed by Howell Boone from the Atlantic Sturgeon netted in the rivers of the Altamaha," promoted one flyer. But the Georgia Department of Natural Resources has concluded that sturgeon have become too scarce in the river to allow them to be taken, at least for the foreseeable future.

Although it never has been dammed, that does not mean people have wanted to leave the river untouched. Thirty years ago an organization called the Altamaha River Basin Commission had a dream. The river and its tributaries would be dredged all the way to Atlanta, up to 333 miles away, depending on the route. As a newspaper article of the time summarized the plan, "It would not only give Georgia one of the

most important ports on the Atlantic, it would produce dozens of great river ports all along the way, stimulate the growth of scores of new industries and connect Atlanta by water with such giants of the heartland as Chicago, St. Louis and Memphis."

That dream is dead now. So is another way of life that once held this low-country region together. Visit the Hofwyl-Broadfield Plantation across the river from Darien. There, under sturdy live oaks where the Spanish moss is backlit by a scorching sun, you will find the remains of a rice plantation established in virgin cypress swamps. Rice was the dream of the plantation owners. Use the fresh water from the river, utilize slave labor, go away in the hot summer months when the mosquitoes are fierce, and reap immense profits from the harvest. Alas, the dream fit the reality for a short amount of time for a small number of people. With the end of the horrific institution of slavery came the collapse of the rice economy.



Now the Nature Conservancy is working to protect the rare animals that take shelter in this place, snakes and all. The Conservancy short-lists the gopher tortoise, eastern indigo snake, West Indian manatee, swallow-tailed kite, Bachman's sparrow, and Rafinesque's big-eared bat as things to be saved, along with plant rarities including the hairy rattleweed, green-fly orchid, Georgia plume, Radford's dicerandra, and slenderleaf clammyweed.

My neighbors and I would add respectfully: Barred owls that awaken us with their questioning hoots, osprey young nested atop dead oak trees, hummingbirds at our feeders, butterflies on our flowers, cormorants in the cypress, quiet times along the lagoons, and the majestic sweep of the river itself.

When I walk onto the terrace of my home, I look directly into a lagoon filled with water from the Altamaha estuary. Standing here with coffee cup in hand, I watch as something unseen causes silvery little fish to flip into the morning air. The ripples wander slowly under the ancient live oak that leans out over the lagoon like a giant green umbrella. Only the jumping fish disturb the serenity.

A great blue heron glides onto the far bank, perhaps 20 yards from where I stand. For 15 minutes it stalks its prey, moving one stilt leg every minute or two. Its graceful neck stretches high and then retreats



The river that begins quietly amid piney woods and cotton fields ends with the roar of surf at Pelican Spit. Here a flurry of royal terns, gulls, and brown pelicans sweep under a tide-pulling moon. Wild creatures find refuge all along the Altamaha, taking comfort in a river left to its free-flowing ways.

into an S curve. Totally concentrated on breakfast, the heron ignores the flock of butterflies that float up from their special flowers, the squawk of the crows somewhere behind me.

My coffee grows cold. I am the heron's rooting section, or maybe his fellow hunter. He takes a step, and I tense up with suspense. Ever so slowly his right stilt moves forward in the water, making no ripple at all when he steps. With all deliberation he elongates his neck just above the water. With no warning his beak is under the water and out. He swallows; I don't ever get a chance to see his prey.

But that is immaterial. I have watched, as so many times in the past, the marvelous world of the estuary. The salt water has met the fresh water here. The rich stew of the upriver nutrients and the ocean life have mixed. The Altamaha has fed two of its citizens, one a long-legged breakfast hunter and the other a man at peace with his world. □

Dolphin talk

Free diving with juvenile spotted dolphins in the Bahamas, biologist Kathleen Dudzinski helps reveal how dolphins communicate with vocalizations and physical contact. Working fin-to-fin with dolphins brings out the kid in a scientist, she says. "It's a real blast!"

BILL STERLING

Labors of Love

A report by your Society's Committee for Research and Exploration

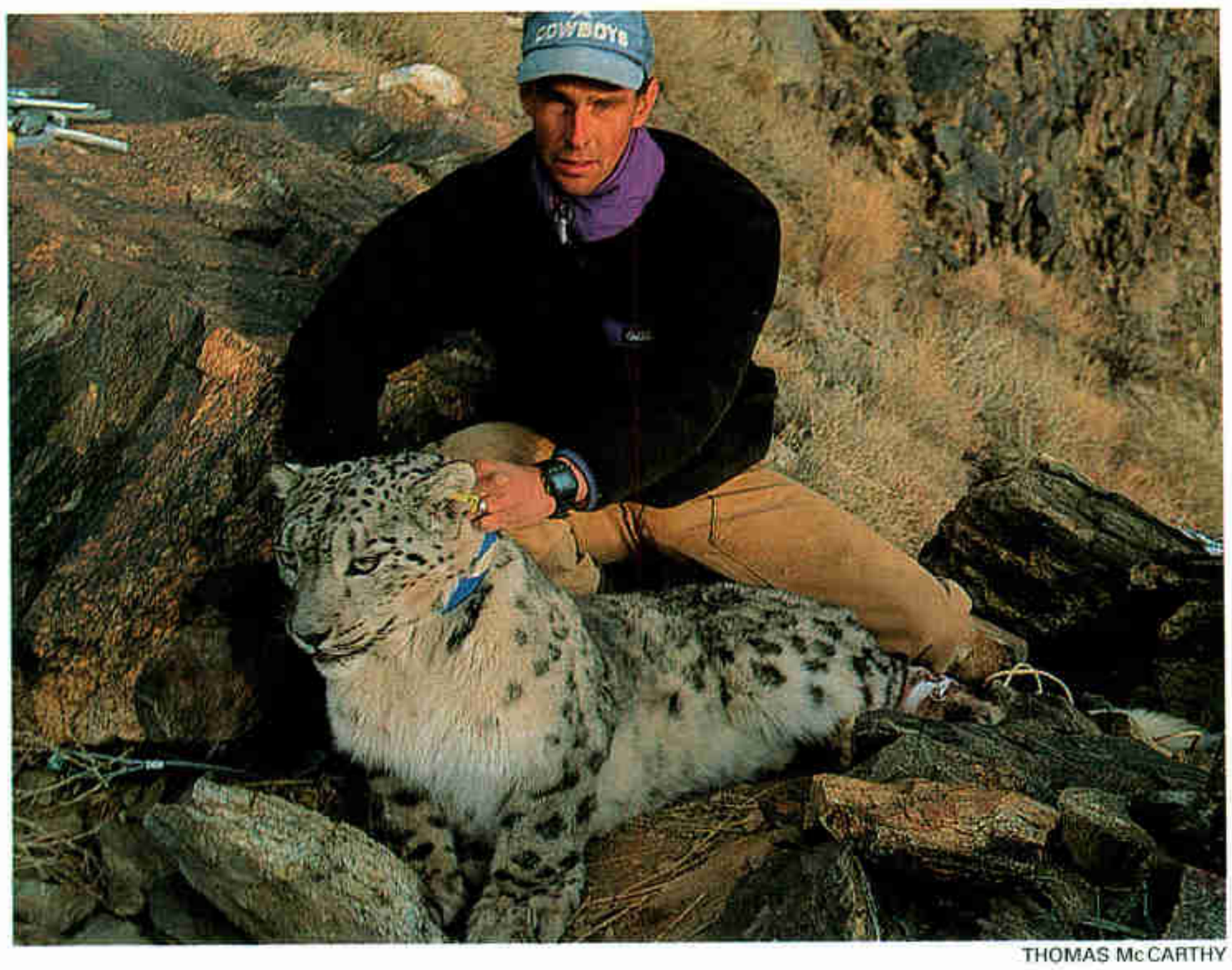
From ocean depths to the highlands of Tibet, and from archaeology to zoology, scientific research around the world was aided in 1997 by more than 200 grants awarded by the Society's Committee for Research and Exploration. While most grantees are leading scholars in their fields—or promising newcomers—this year Maya villagers from Belize joined their ranks. Supported in part by the Society, villagers compiled and edited a regional atlas. By mapping their own landscape and cultural patterns, they can better understand—and cope with—issues of development and conservation that will affect their lives and the lives of their children.

—GEORGE E. STUART, CHAIRMAN

"We've learned more about wolf predation in Yellowstone in the past two

Snow leopard study

▶ Most elusive of the big cats, snow leopards inhabit the mountainous back-country of central Asia. Yet even there, human-related habitat loss and illegal hunting threaten this endangered species. In a three-year project wildlife biologist Thomas McCarthy used radio collars and lots of leg power to study leopard ecology while working with Mongolian scientists to preserve this rare and beautiful cat.



THOMAS McCARTHY

years than we have over decades in other places." —DAVID MECH, RESEARCH GRANTEE



JOEL SARTORE

Yellowstone wolves

▲ When wild wolves were reintroduced into Yellowstone National Park in 1995, biologist David Mech, shown above with captive wolves in Minnesota, was ecstatic. With Yellowstone's Michael Phillips and Douglas Smith, he studies how wolves interact with animals never before exposed to them. Using radio collars and ground and aerial surveys, Mech sees the wolves thriving on the park's generous supply of elk.



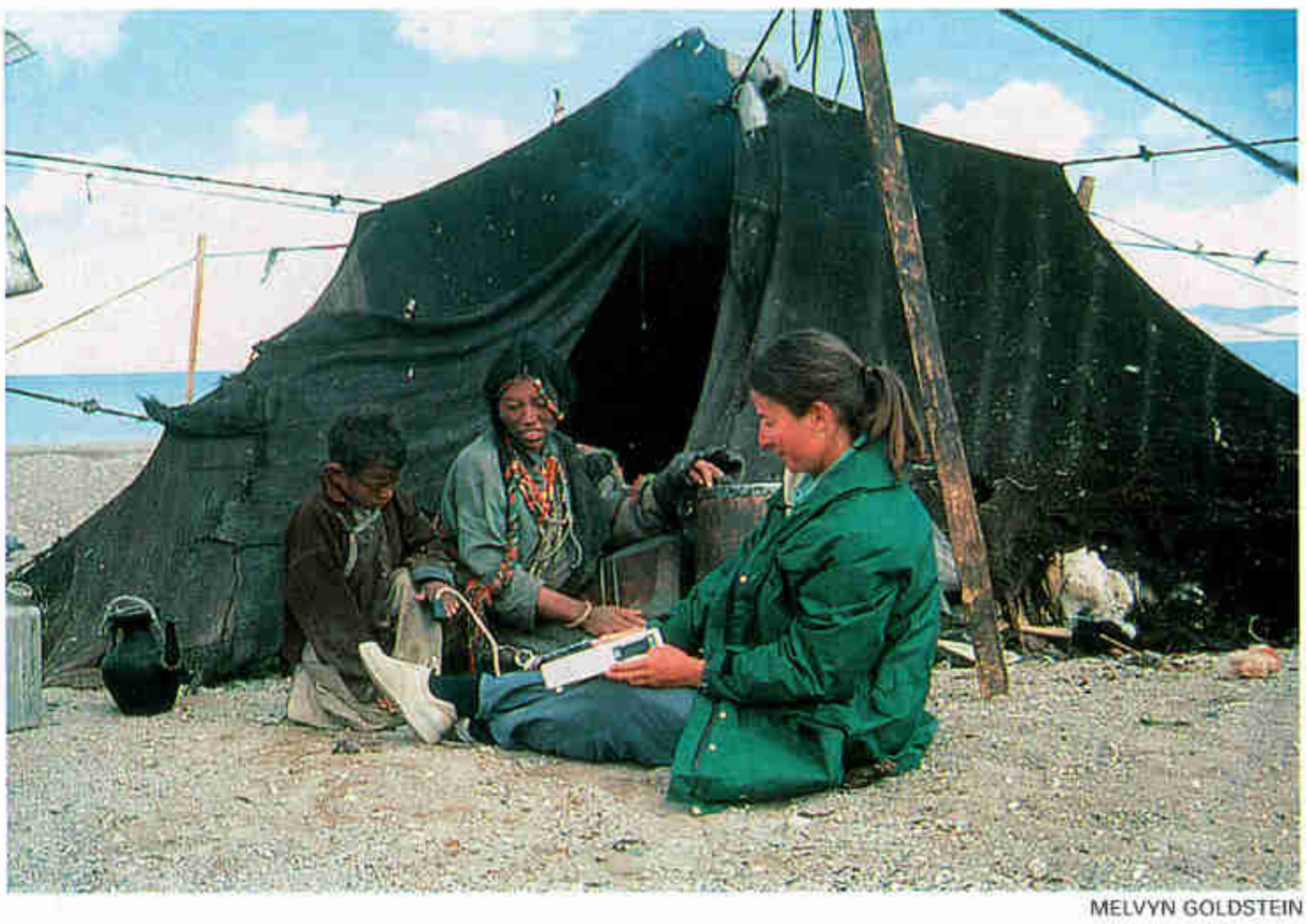
JOHN ANDERSON

Sleuthing giant squid

▲ A sperm whale carcass in New Zealand shows signs of a struggle—sucker marks—leading marine biologists Clyde Roper and Malcolm Clarke (with camera) to suspect a giant squid. Up to 60 feet long, it is a mystery mollusk, having never been seen alive in its deep-sea lair. Roper hopes to change all that by lowering a robotic camera into a 3,000-foot canyon just offshore of this New Zealand beach.



AMANDA COLOMBO



MELVYN GOLDSTEIN



Amazon monkeys

▲ Largely unknown to science, the black uakari monkey of Brazil is giving up its secrets to primatologist Jean Philippe Boubli, who hires Yanomami hunters to assist him in finding and observing the monkeys. Black uakaris live in groups of up to a hundred individuals, the largest reported for any New World primate. They inhabit the environmentally diverse Pico da Neblina National Park in northwestern Brazil.

Adapting to altitude

▲ Sampling blood without pricking a finger, anthropologist Cynthia Beall uses beams of light to measure oxygen levels in a young Tibetan friend. "At this altitude—5,000 meters—all people have very low levels of oxygen saturation," says Beall, "but in some they are not so low." She recently found that the trait is partly genetic, and next plans to take up the question: "Are these people better adapted, and how so?"

Impacts on early earth

▲ On a remote road cut in Western Australia, in layers of sediment deposited 2.6 billion years ago, geologist Bruce Simonson found tiny beadlike grains of glass—evidence, he believes, of a colossal meteorite impact. By comparing them with spherules collected on other continents, he hopes to reconstruct what our planet looked like back in the "good old days"—when one-celled organisms ruled the earth.

earth looked like as an infant." —BRUCE SIMONSON, RESEARCH GRANTEE

BRUCE SIMONSON



JESÚS LÓPEZ

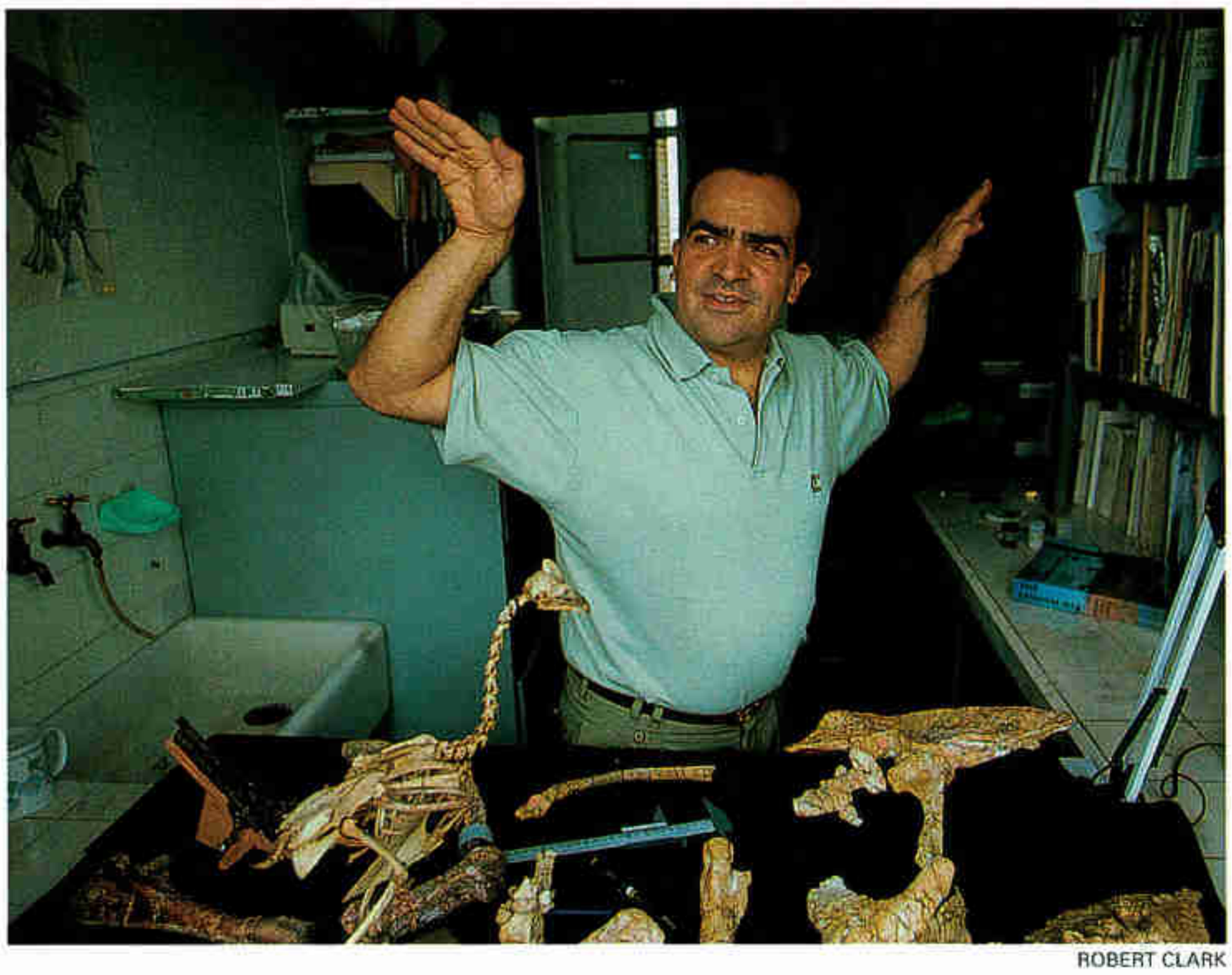
Mapping Maya lands

◀ The grassroots movement in regional geography took a leap forward this year with the publication of the *Maya Atlas*. Forty-two communities in southern Belize mapped their own landscape and culture, arming themselves for the future—with knowledge. Says committee chairman George Stuart: "The Society's mission to increase and diffuse geographic knowledge has never taken more appropriate form."

"This site is a window on the interplay between humans and their subtly

Dinosaurs to birds

▶ Working in Patagonia, paleontologist Fernando Novas found fossils of a new species of Cretaceous dinosaur believed to be the most bird-like dinosaur yet. A seven-foot-long carnivore with long, powerful legs, *Unenlagia comahuensis* did not fly but held its forelimbs in a wing-like manner, as Novas demonstrates. The structure of its pelvis and hind limbs resembles the much earlier *Archaeopteryx,* earliest known bird.



ROBERT CLARK

shifting environment through history." —JAMES ADOVASIO, RESEARCH GRANTEE



KENNETH GARRETT



JEFFREY PETTIT



ANNA ESTES

New World antiquity

▲ Brandishing a trowel and a can of compressed air, archaeologist James Adovasio directs the meticulous preservation of Meadowcroft Rockshelter in Pennsylvania, where he has found evidence of human habitation 12,000 to 14,000 years ago. Oldest known human site in North America, Meadowcroft was damaged by erosion in 1994. Adovasio seeks to stabilize the site and resume study of its contents.

Herd-watching in Ngorongoro Crater

▲ In 1963 zoologist Richard Estes was awarded his first research grant from the Society and used it to launch the first ever study of wildebeest behavior in Ngorongoro Crater, Tanzania (top). In the years since, Geographic support has enabled him to conduct studies on subjects as diverse as the giant sable antelope and African wild dog. Now 70, Estes returned to Ngorongoro last year with a new sense of urgency. For reasons not yet fully understood, the crater's populations of ungulates (wildebeest, buffalo, and zebra among them) have fallen by a third since 1986. During the past two years its lions mysteriously declined by half, then rebounded. Is this a natural cycle, or are settlements and tourist lodges on the crater rim responsible, perhaps robbing herbivores, the lions' prey, of water? Estes aims to find out. □

The Netherlands
Ode to Ice

Schzz . . . schzz . . . schzz . . . the rhythmic push and glide of steel blades on frozen water is music to the Dutch soul. When icy canals fan out across the land like rays of sunlight, skaters warm to their national obsession, captured here in a portrait begun two decades ago.

Photographs by Co Rentmeester



Rembrandt, Hals, Vermeer—the Dutch masters might have painted a scene like this 1979 view of Kinderdijk, known for windmills that once



pumped water off the land. This mill, dating from 1520, burned down last year. It will be rebuilt, an icon as treasured as the skaters' timeless pursuit.

Bitter cold ignites celebration in Hindeloopen, a 13th-century trading port whose frozen canal becomes a stage for *schoonrijden,* or "fancy



skating." "It's a lot of fun," says Gerda Rinkes, second woman from the left. "And it's a part of our culture that I don't want us to lose."

Ice draws the Dutch outdoors with a primeval force as old as their history. Ask anyone there why, and the answer is the same: "Because there's so much water." With one-quarter of the nation below sea level and nearly half its land reclaimed from the sea, the Netherlands is laced with canals, lakes, rivers, and drainage waterways. When winters are cold enough, these freeze into magical avenues for skating and celebrating Dutch culture with elaborate events such as races with horse-drawn antique sleighs (above).



A deep freeze is rare, which adds to the allure. "Our winters are influenced by the Gulf Stream and therefore are rather rainy and bland," says Co Rentmeester, who was born in Amsterdam. "But when winter is strong and very cold, the lakes and canals freeze, and the Dutch become like Olympians. It's a national passion."

Last winter was strong enough to hold the famous Elfstedentocht, or Eleven Cities Tour, a 200-kilometer (124 miles) skating marathon through 11 medieval Frisian towns that drew more than 16,000 skaters and half a





million onlookers. Such events give the usually antinationalistic Dutch a chance to cheer their countrymen—and their accomplishments. "We can walk on water and see the lands we made with our own hands," says historian Herman Pleij with a laugh. For Dutch skating champion Ria Visser, the appeal is more soulful: "To be in nature with the cold and the silence and the elegant movement of skates, it's like flying. You feel free." — Text by LISA MOORE LAROE

Once churned by 17th-century trading ships during Holland's Golden Age, the inner harbor at Hoorn lies in the still grip of winter. Traditional



schooners no longer used for fishing will come alive in summer, when the retooled ships cruise the IJsselmeer, the Netherland's inland sea.



Pirouettes and *prikslees*—tiny sleds propelled by iron-spiked sticks—share the ice with diligent ducks in Broek in Waterland, an affluent village



north of Amsterdam. Less fond of ice than the Dutch, these ducks gather in a hole, or *wak,* they created—and nestle on a halo of donated straw.



"For children the night is very romantic," says Ellen van der Linden, recalling this night 19 years ago (above) when she and her daughter



joined friends for a torch-lit stroll on frozen waterways. Such scenes repeat themselves as each generation sculpts new memories from winter's frost.

"One and all are possessed with the spirit of motion," wrote Mary Dodge in her classic tale of Hans Brinker. The obsession still holds in the



Netherlands, where some 10,000 countrymen skated the 115-kilometer Eleven Lakes Tour last winter (above)—for ego, for exercise, for the pure love of ice. □

SEAVER CENTER, LOS ANGELES COUNTY NATURAL HISTORY MUSEUM (BELOW); COLLECTION OF THE NINETY-NINES, INC.



Amelia Earhart

By Virginia Morell
Photographs by Sarah Leen

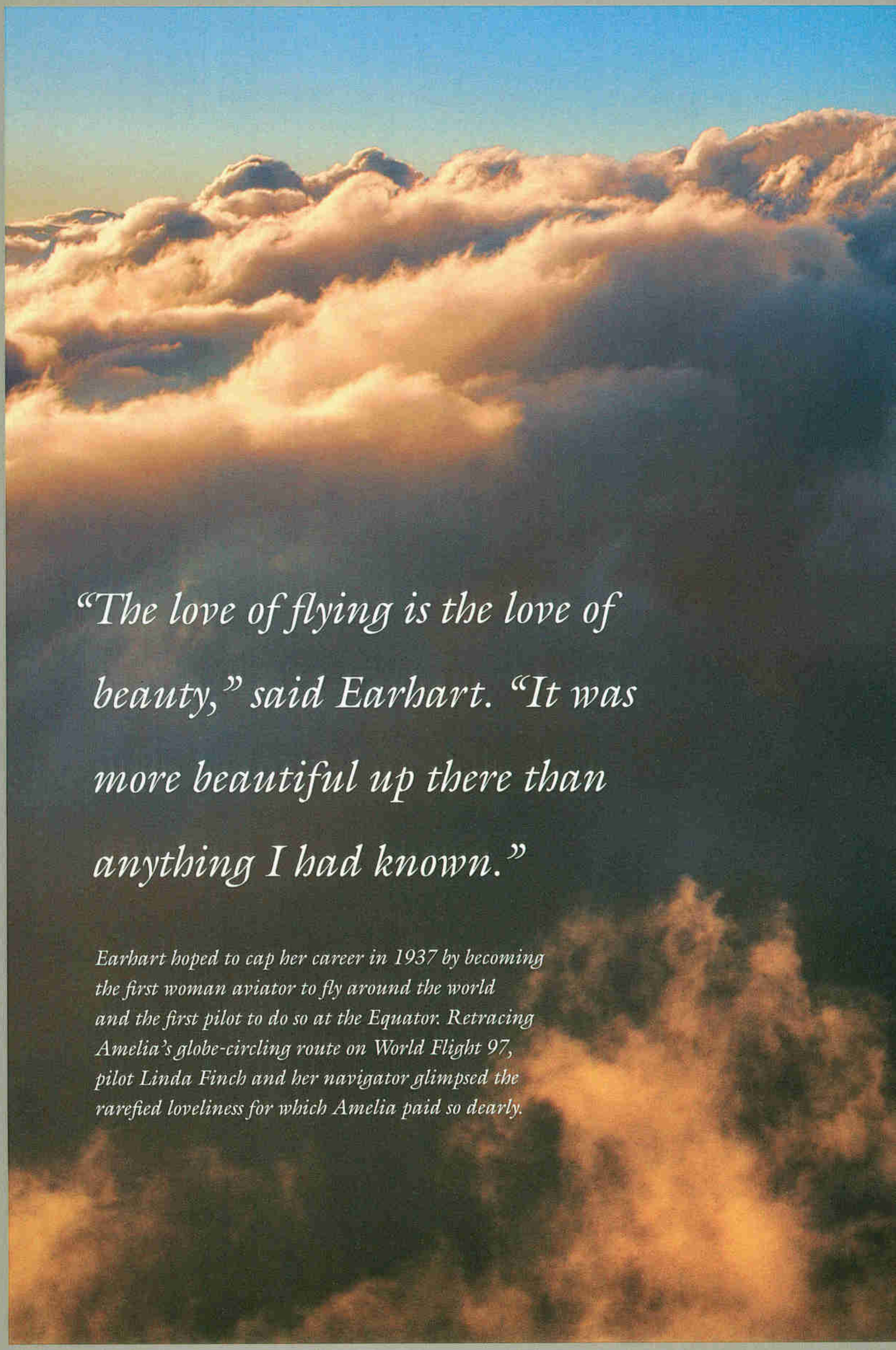
ON THE MORNING of July 2, 1937, in Lae on the island of New Guinea, Amelia Earhart started the engines of her Lockheed Electra. She listened for a moment to their deep-throated roar, a sound she had once likened to poetry, then pointed the silver plane down the runway. Heavily laden with more than a thousand gallons of fuel, the Electra lumbered along toward a rocky sea embankment that marked the runway's end. Less than 50 yards from the precipice, Earhart lifted her plane into the air. It sank momentarily, then began a slow but steady climb into the clouds. Minutes later it was gone from view. The small crowd of onlookers let out a cheer.

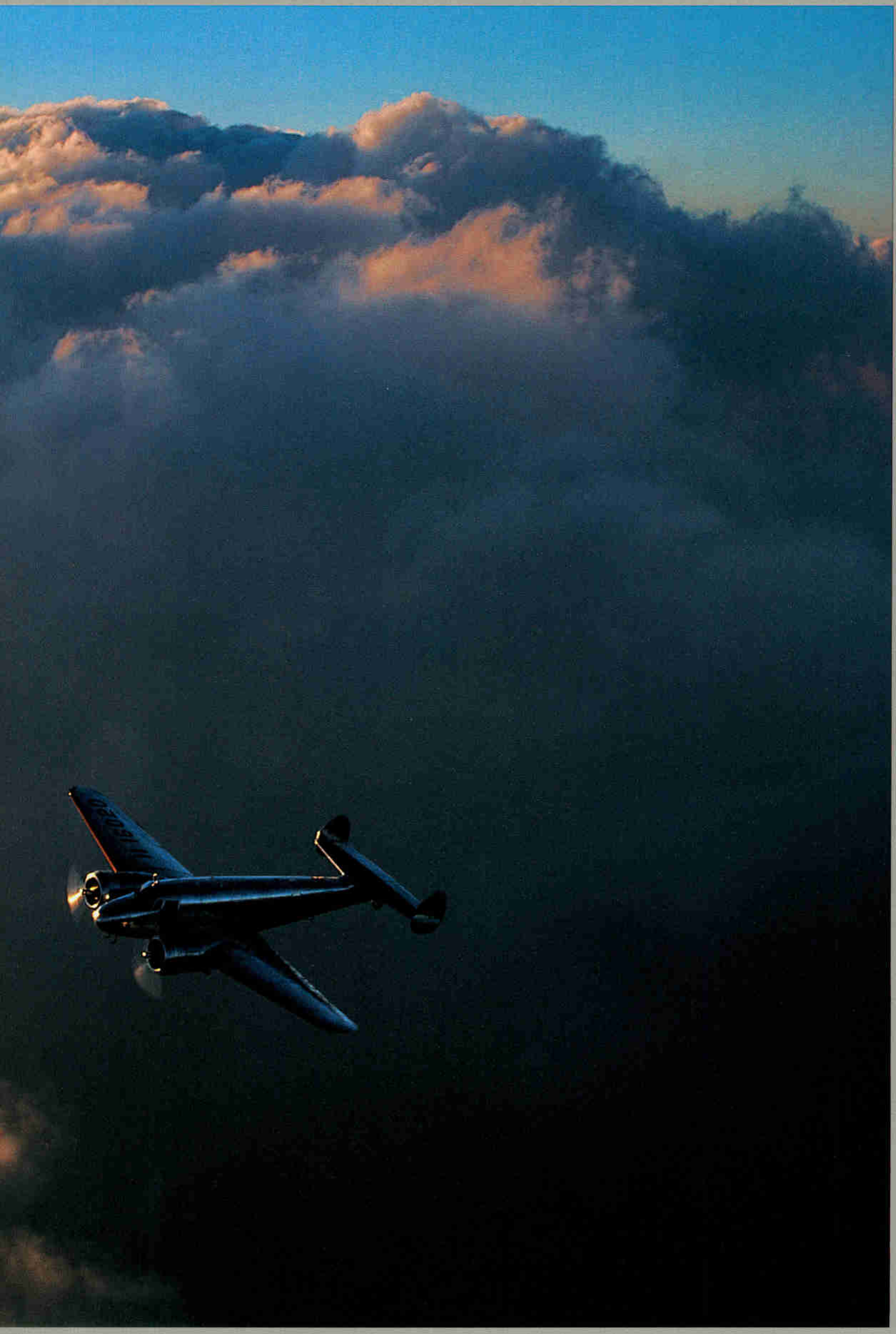
Earhart and her navigator, Fred Noonan, were bound for Howland Island, a 2,556-mile journey and the longest leg of their flight around the world. No man had yet flown a plane around the world at its widest point, the Equator, as Earhart was doing, nor had any woman pilot ever circumnavigated the globe. At the end of her 29,000-mile journey, she would have these records to add to an already impressive list of aviation firsts, including being the first woman to solo the Atlantic. It would be her last such "stunt" too, she'd confided to a reporter at the beginning of the flight. Afterward she'd like to live a quiet life.

That dream never happened. Those who turned out that misty morning to watch her departure from Lae were the last ever to see

FLYING MADE HER FAMOUS. *Disappearing made her legendary. More than 60 years after Amelia Earhart lifted her gleaming Electra (above) into the sky for the last time, audiences still devour stories of her headline-grabbing adventures. Certified as an aviator (right) only two decades after the Wright brothers' first flight, Earhart used her fame to promote air travel and equal opportunities for women aloft.*


EARHART
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Chairman
Vice-Chairman
Amelia Earhart


"The love of flying is the love of
beauty," said Earhart. "It was
more beautiful up there than
anything I had known."
Earhart hoped to cap her career in 1937 by becoming
the first woman aviator to fly around the world
and the first pilot to do so at the Equator. Retracing
Amelia's globe-circling route on World Flight 97,
pilot Linda Finch and her navigator glimpsed the
rarefied loveliness for which Amelia paid so dearly.



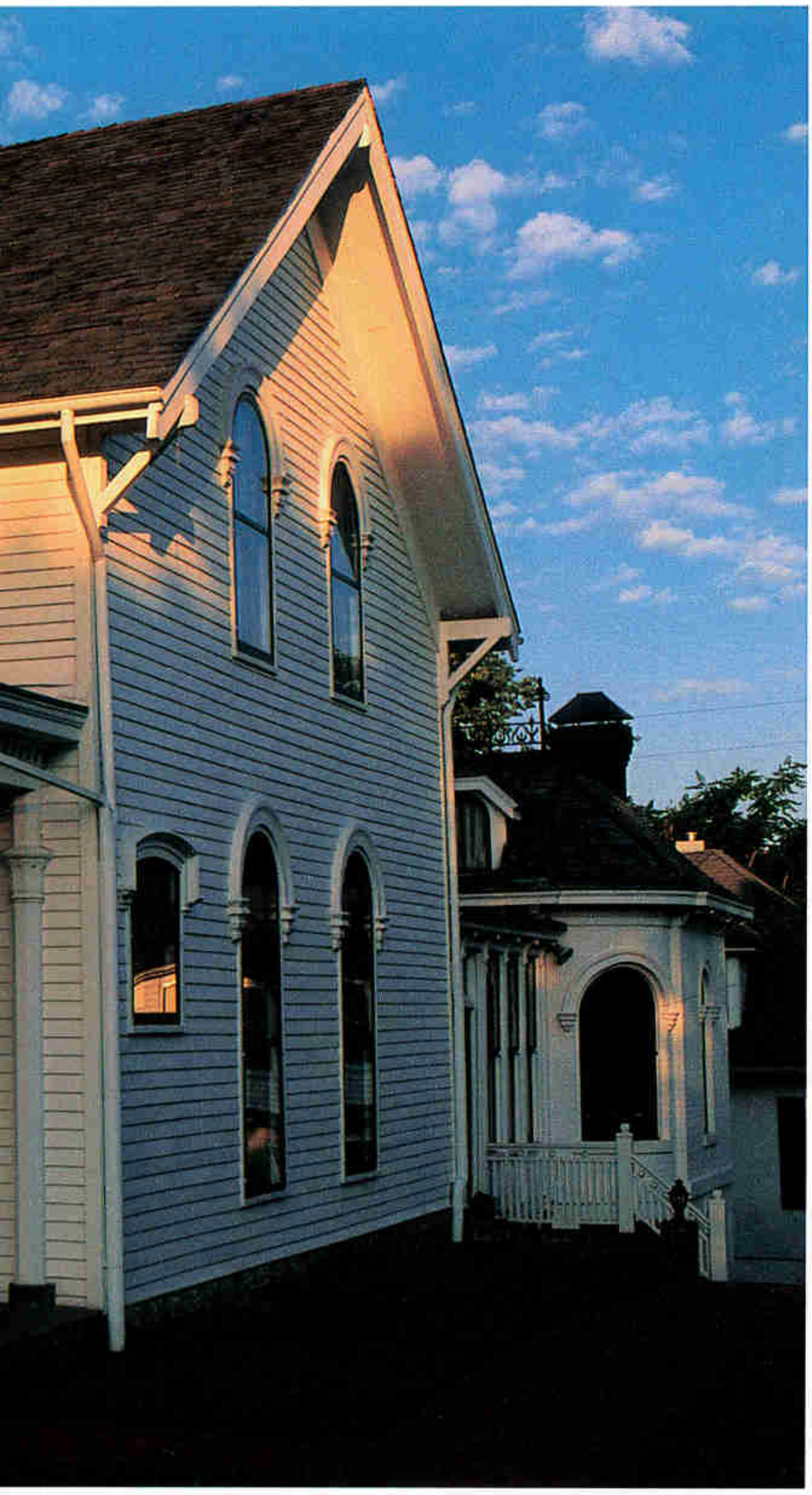


Earhart or Noonan, the last to hear the poetry of the Lockheed's engines. Somewhere over the Pacific, the plane vanished. America had lost its Sweetheart of the Air, its lovely Lady Lindy.

Yet, as a measure of her fame, Earhart is as well-known today as she was the day she disappeared 60 years ago. Part of this enduring celebrity rests upon the mystery surrounding her last flight—now heavily embellished with conspiracies, "secret files," and "clues" that wash ashore on South Sea islands with almost the frequency of UFO sightings in New Mexico. But much of her durability as a legend comes from the fact that Earhart is one of the few American heroes whose reputation has remained virtually untarnished.

"You know, she was flying competitively for only nine years," says Fay Gillis Wells, also one of America's pioneering women pilots and a friend of Earhart's. "Yet in that short time she became better known than any other woman pilot in the world. And even after all those years, we're still talking about Amelia. Who would have thought it?" Wells smiles. "It must be her spirit. That's what people loved about her then—and still do. She inspires them."

VIRGINIA MORELL, a contributing correspondent for *Science*, is the author of *Ancestral Passions: The Leakey Family and the Quest for Humankind's Beginnings*. Assignments for NATIONAL GEOGRAPHIC have taken freelance photographer SARAH LEEN from California to Siberia and most recently to Oregon (August 1997).



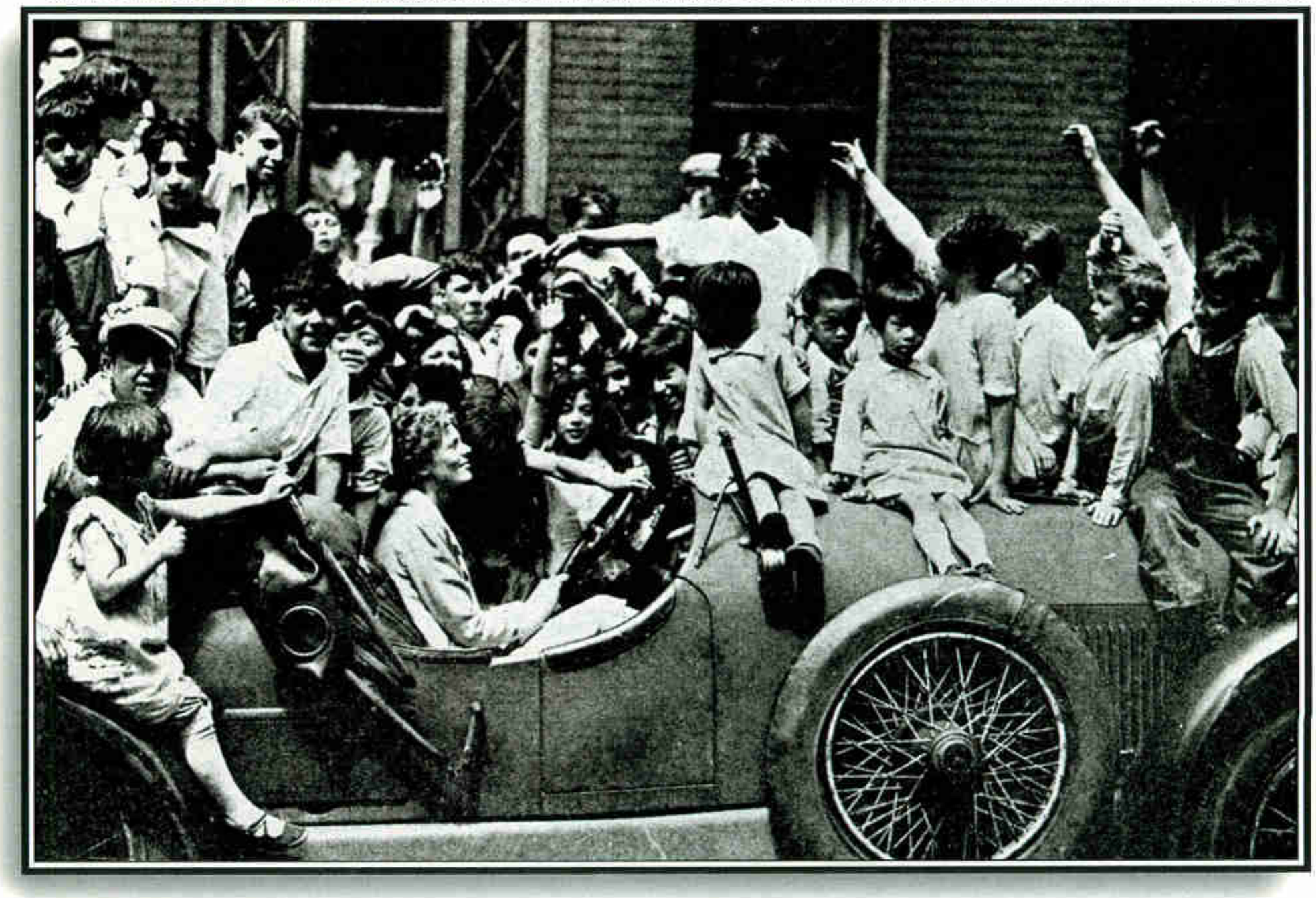
WHEN A STRANGER *announced "I'm from your hometown," Earhart often replied, "Which one?" Born in her grandparents' home in Atchison, Kansas, now a museum (left), Amelia moved often—from Kansas City to Des Moines to St. Paul, where the 17-year-old (below) played basketball and studied Latin. Amelia's niece, Amy Kleppner (bottom, at the Earhart birthplace), remembers in poignant detail filigree and spun-glass bracelets Amelia sent from Asia for her sixth birthday. The gifts arrived days after Earhart vanished.*



SCHLESINGER LIBRARY, RADCLIFFE COLLEGE



SALLY PUTNAM CHAPMAN COLLECTION (BELOW); EARHART BEFORE 1928 ATLANTIC CROSSING, NATIONAL AIR AND SPACE MUSEUM, SMITHSONIAN INSTITUTION



THOUGH A PASSENGER, *not the pilot, on her 1928 Atlantic flight, camera-shy Amelia soon grew adept at handling reporters eager for a story about the first woman to complete the crossing by air. Earhart had expected to resume work at a Boston settlement house. Celebrity brought a flood of writing and speaking requests, however, and she returned to Denison House only briefly, to pose for a publicity shot (above).*

Almost as soon as Earhart vanished in the Pacific, others were talking about completing her world flight. "As soon as I finish school," one 15-year-old girl wrote to George Palmer Putnam, whom Amelia married in 1931, "I intend to take up flying . . . and within a few years intend to duplicate Amelia's flight. . . ."

Many shared the same dream, but not until 1964, 27 years after Amelia's disappearance, did a woman achieve that goal. In fact two American women, flying independently and following different routes, circumnavigated the globe that year: Geraldine (Jerrie) Mock and Joan Merriam Smith. Mock, in a single-engine Cessna, was the first woman to circle the earth, flying slightly north of the Equator for much of the trip; Smith, flying a two-engine Piper Apache, was the first to follow Amelia's equatorial route. Since then several other women have followed the so-called Earhart Trail.

Some have taken the challenge because, Amelia-like, they wanted to show the stuff they were made of; others to mark Earhart's last flight or simply to honor her memory. In 1967 Ann Holtgren Pellegreno piloted a restored Lockheed Electra, the same type of plane Amelia had flown, along the Earhart Trail, thereby adding an air of historical authenticity to her trip. Last summer Linda Finch, a Texas businesswoman, did much the same thing, flying close to the Earhart Trail in a 32-year-old Electra with new engines built from pristine vintage parts found in an Italian warehouse.

Try as they will, those who set out to experience the challenges Earhart took on cannot succeed in capturing the public's imagination as Amelia did. Any re-created journey, although hazardous, is simply not novel enough to generate the electricity Amelia's sparked as she headed unencumbered into the unknown. Earhart (who'd flown the Atlantic with scarcely more than a scarf, a toothbrush, and a comb) and Noonan each traveled with one small bag so as not to add extra weight to the plane. For the Lae to Howland Island leg they eliminated every extraneous thing, from parachutes to Earhart's lucky elephant-hide bracelet, which weighed next to nothing.

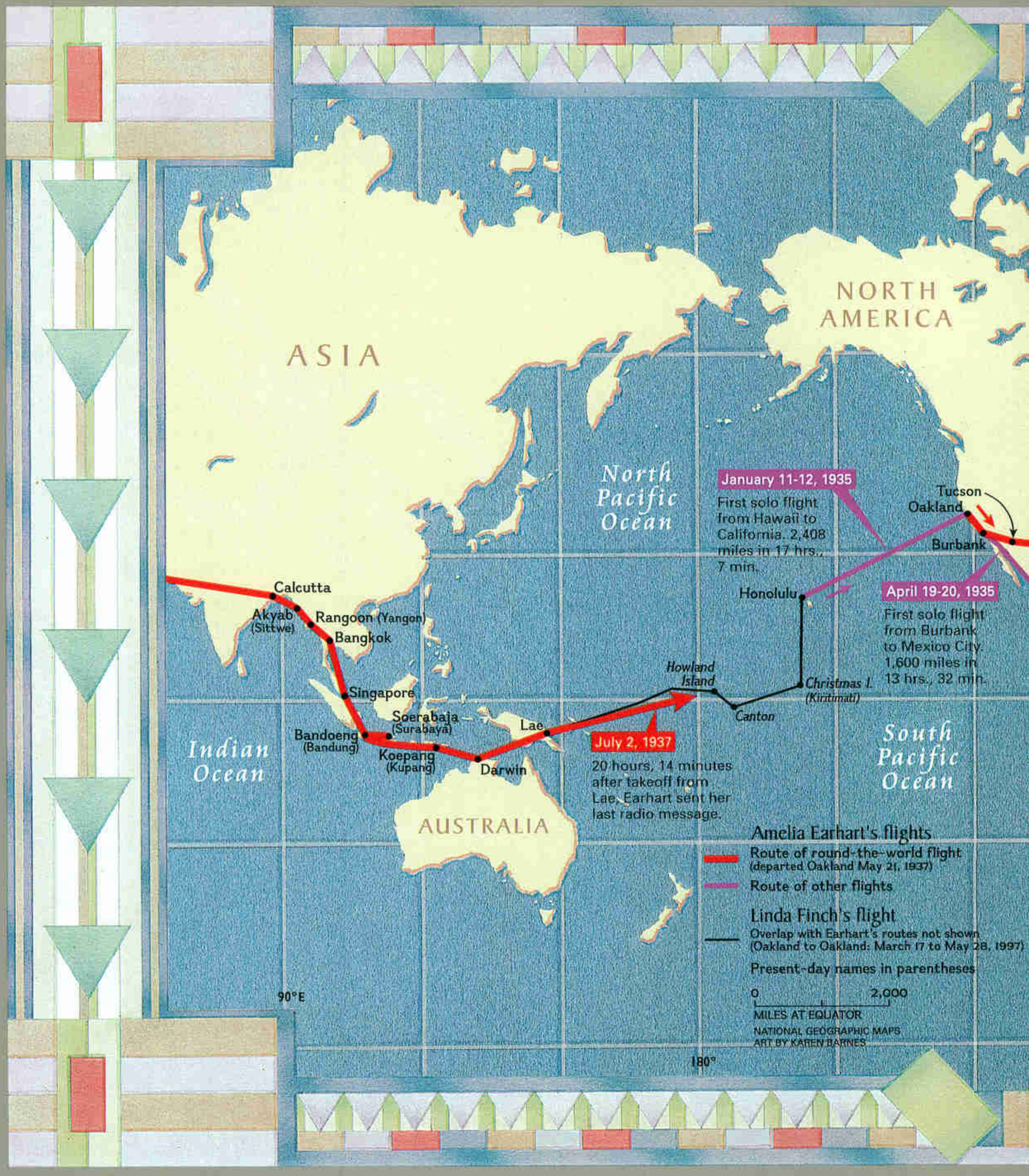


That bracelet, embellished with silver, lies today in a display case at the Oklahoma City headquarters of the Ninety-Nines, the international organization of women pilots Earhart helped found in 1929, named for its number of charter members. Holding the bracelet in my hand, feeling its featherlike weight, I was struck by what it meant for Earhart to have removed it, how anxious she must have been about the journey to Howland Island.

AMELIA EARHART stepped onto the world's stage—and into people's hearts—in 1928, after becoming the first woman to fly across the Atlantic. That the two men who actually flew the plane had not once allowed her to touch its controls (although she was a licensed aviator) hardly seemed to matter. While she was protesting that she'd been little more than a "sack of potatoes" during the 20-hour-and-40-minute flight, the world was hoisting her on its shoulder, proclaiming her a heroine. After all, Charles Lindbergh had soloed the same seas only a year earlier and, in the preceding ten months, 14 pilots—three of them women—had perished trying to duplicate his feat.

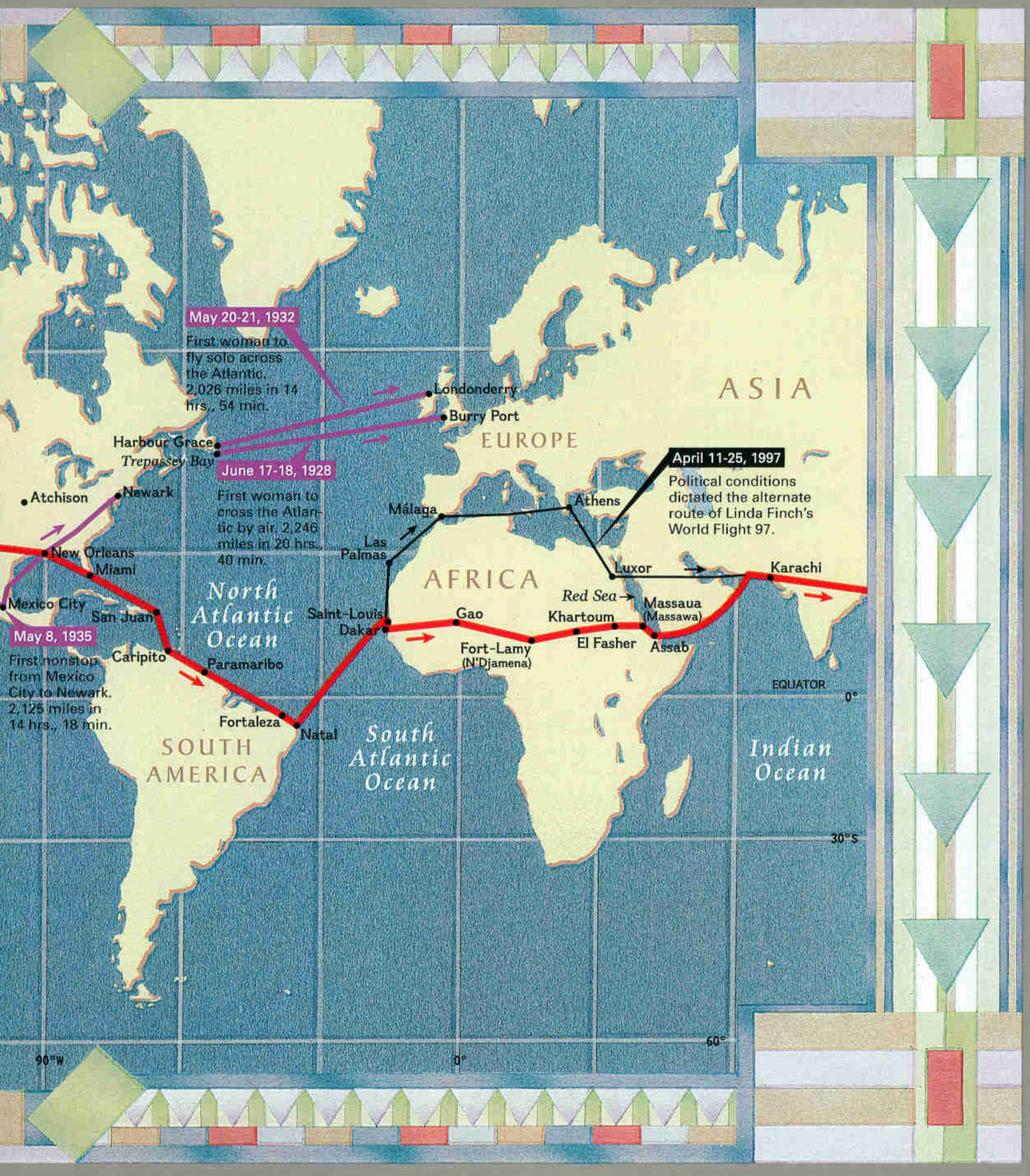
Amelia's insistence that the two male pilots deserved all the credit only made the crowds cheer more. Earhart was the "real American girl," as modest as she was courageous, sang the newspaper editorials. What more could one want in a heroine? Her self-deprecating sense of humor and physical resemblance to Lindbergh only heightened her appeal. They were both blond, tall, and slim, with strong jaws and high foreheads and the same direct look of confidence in their blue eyes.

Overnight the 30-year-old pilot, who had been teaching immigrant children in Boston before her flight, found herself hailed as a role model. Very few American women then sought careers in such male-dominated professions, and Earhart's success opened a window on a world that had been all but forbidden. "Our great-grandmothers had to keep their wings clipped like discontented little birds," a 13-year-old schoolgirl wrote a few years later in an essay about Amelia. But now, like a "beautiful white swan," Earhart had shown young women how "to fly the air. [She] led the way that others might dare to follow."



The Earhart Trail

The fateful challenge Amelia Earhart and navigator Fred Noonan faced as they took off for Howland Island on July 2, 1937, has often overshadowed the display of raw endurance that came before. After leaving Miami, they flew 24 hops covering 19,000 miles in 30 grueling days. South American jungle, "least desirable of all possible landing places," gave way to tornadoes and sandstorms across Africa. Forbidden to fly over the Arabian Peninsula, the 39-year-old pilot



claimed her last record with a 13-hour, 1,920-mile nonstop trip from the Red Sea to Karachi. Blinding rain beat the paint off the Electra from Calcutta to Rangoon. All this in a cockpit (right) that measured less than 5x5x5 feet.

AMELIA EARHART



ALBERT L. BRESNICK

Fay Gillis Wells was one of those. In 1929, the year Wells earned her pilot's license, the "papers were just full of Amelia," she recalled, as well as stories about other pioneering women aviators. They were organizing the first Women's Air Derby, a cross-country plane race, and it occurred to Wells, then 20 and directionless, that "aviation must be here to stay." She went "right out and signed up for lessons" and soloed three weeks later.

"Women must try to do things, as men have tried," Amelia wrote to her husband in 1935 before soloing from Mexico City to New Jersey, another record-setting venture. "When they fail, their failure must be but a challenge to others."

LIKE ALL great passions, Earhart's love of flying hit her suddenly. She was 21 and working as a nurse's aide in a hospital in Toronto, tending the maimed and dying from the battlefields of the Great War. It was November 1918, and for a break from her duties she went to a local airfield. She watched transfixed as a plane took off in the snow. "The backwash of the propellers threw burning, biting snow into my face," she wrote 14 years later. "It was like the finest cold shower you ever imagined. I determined then that I would some day ride one of these devil machines, and make it blow snow to *my* will."

The elder of two daughters of an alcoholic railroad lawyer and a genteel mother, Earhart seems to have been born with a daredevil streak. Her mother catered to it, dressing her in bloomers, outfits that "shocked all the nice little girls," as Amelia later put it, in their town of Atchison, Kansas. With bloomers billowing, she'd sped downhill on her sled, belly down, the way the boys did it; she'd popped off rats with a .22 in her grandfather's barn and explored the dark caves in the cliffs above the Missouri River. To Earhart, learning to fly seemed no more daring than these stunts, and by 1921 she had a license to compete.



THE POND BUREAU

Seven years later, while working with the immigrant children in Boston, she received a phone call from Capt. Hilton H. Railey, a former Army pilot. Would she, Railey asked, be willing to fly the Atlantic? Amelia said yes: "Who would refuse such a shining adventure?"

Railey had been chartered by George Putnam, the publisher and public relations whiz who later married Earhart, to find a woman pilot capable of flying the Atlantic. Putnam had made a best-seller out of Lindbergh's

post-flight account, *We,* and now wanted to manage a similar flight by a woman. Amelia's name was the first to pop up; she spent her weekends flying at an airport near Boston and had been noticed by one of Railey's friends, who thought her "earnest." Her resemblance to Lindbergh, then the most famous man in the world, clinched the deal.

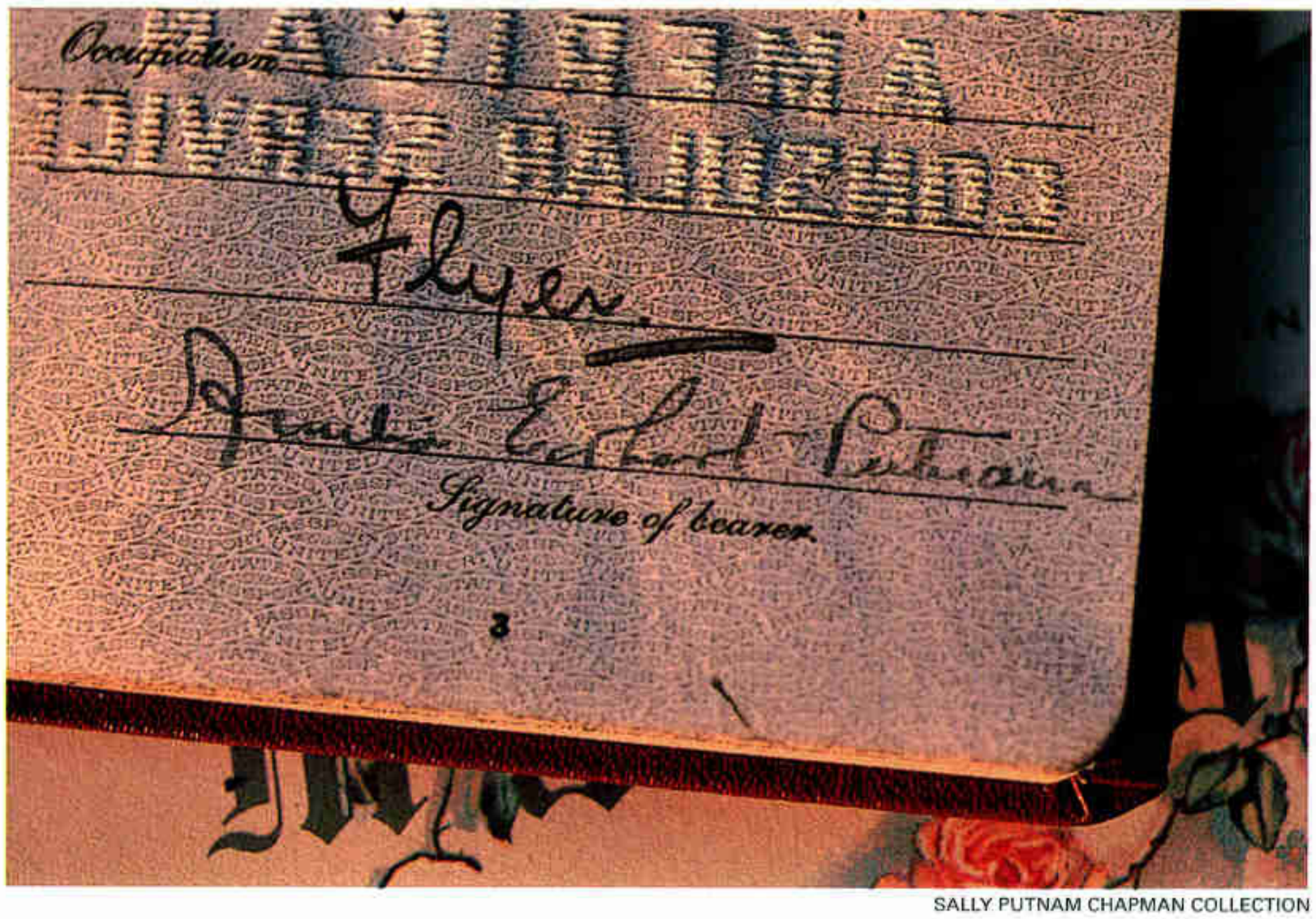
Three months later, on June 17, 1928, Earhart climbed aboard the *Friendship,* a trimotor Fokker, and with Wilmer Stultz at the controls and Louis Gordon in the copilot's seat was airborne for England. At this point Amelia had only a few hundred hours' flying experience and didn't expect to take off or land the plane. But she had been led to believe that she'd fly the craft part of the way; she never imagined being nothing more than a "sack of potatoes." Earhart would later attribute the men's reluctance to give up the controls to bad weather. Regardless of the reason, she spent most of the flight behind the cockpit, peeking out a window at the clouds and ocean below and writing up the flight's logbook. "My status, in fact, was slightly below that of the back-seat driver," she later wrote, "because I couldn't even shout loud enough to annoy the pilot."

The experience embarrassed yet inspired her. Almost as soon as she returned to the States (where New York City honored her with a ticker-tape parade), she resolved to cross the Atlantic again—alone. "For me, the adventure was incomplete," she said. "I had been on the sidelines when I wanted to play the game itself."

Four years later Earhart not only played the game—she won it, becoming the first woman pilot to solo the Atlantic. She owned a bright red Lockheed Vega, a single-engine plane bought with money from her writings and lectures. She'd learned to fly with instruments and had crisscrossed the continent, picking up speed and altitude records along the way.

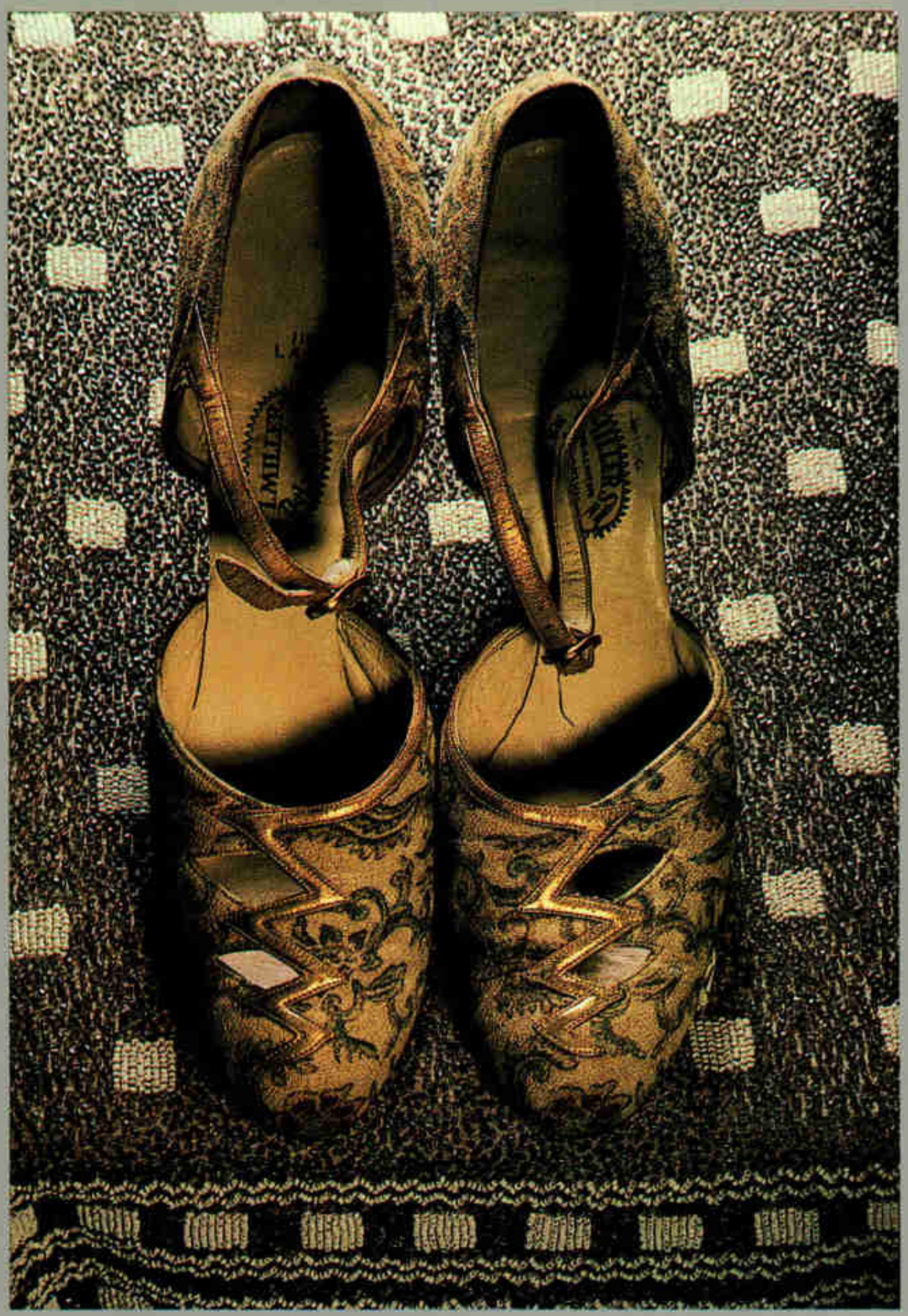
Others then and now have dismissed Earhart's piloting skills, saying she was not much more than an amateur. "Her courage was phenomenal," notes Elinor Smith, who was voted best woman pilot in the U.S. in 1930, "but as to her flying skills—well, those were laughable." Indeed Amelia had her share of crack-ups, but so did nearly every pilot then flying, often because the planes themselves were poorly built. "Some of them weren't made of much more than wood and baling wire," jokes Fay Gillis Wells, who recalls that Amelia "never claimed to be a great pilot. But you can't dispute the records she set or forget that she walked away from every landing, even her forced ones. And her solo flight over the Atlantic—she had to be a pretty smart cookie to survive that."

Earhart never suggested her 15-hour flight from Harbour Grace, Newfoundland, to



SALLY PUTNAM CHAPMAN COLLECTION

EARHART SPENT *a sometimes solitary decade bouncing among schools, part-time jobs, and short-lived business ventures before her first Atlantic crossing put her in the newsreels (at Southampton, England, facing page). By the time of her 1932 transatlantic solo, she had a husband, publicist George Palmer Putnam, and a career to list on her passport (above): Amelia was a flier.*



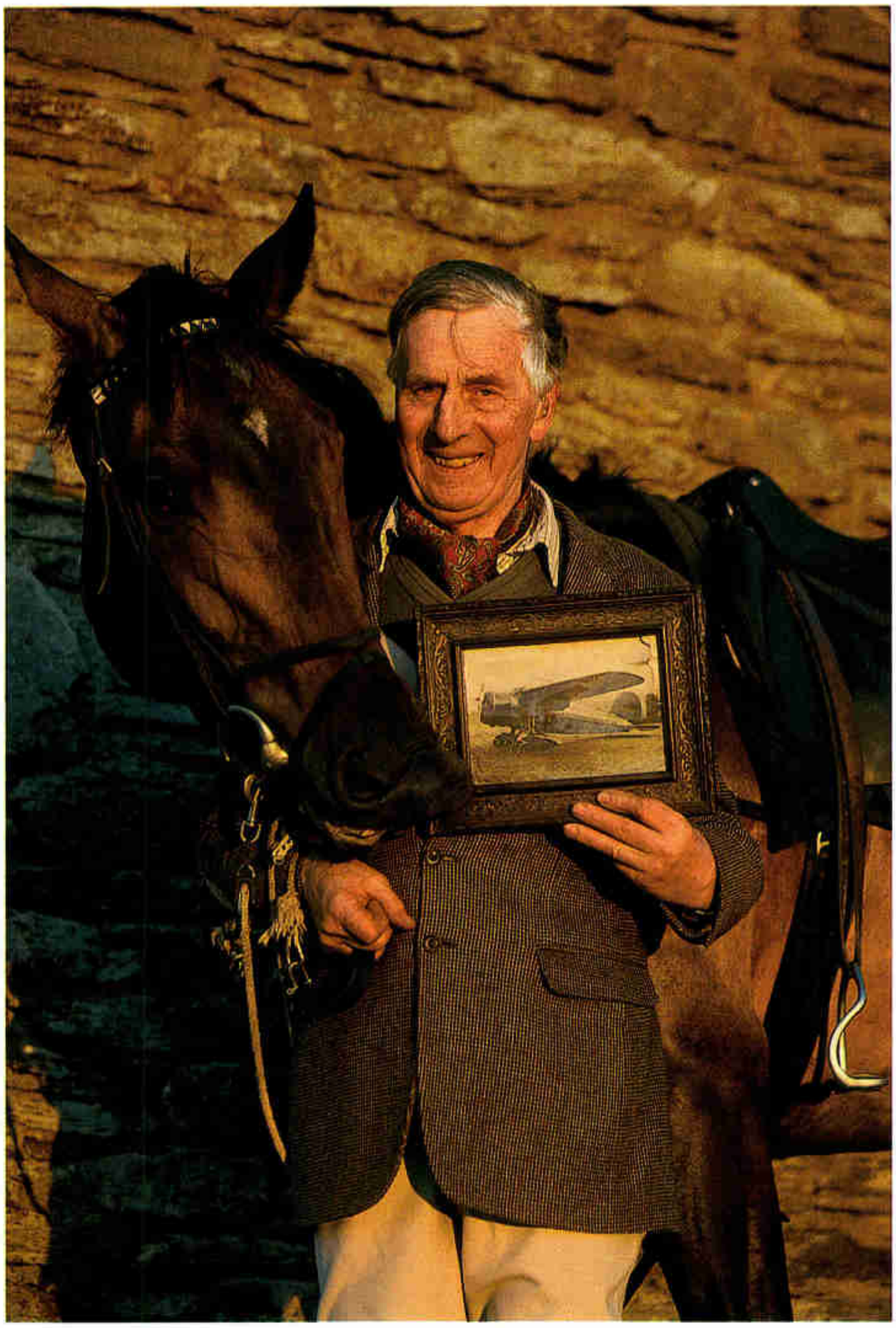
FAMOUS *as a trouser-clad, tousle-haired daredevil, Amelia also delighted in fripperies like the dress shoes and beaded gown at left. Clothing she designed (label, right), with tiny silver propellers for buttons, sold at Macy's department store in 1934.*

Her femininity could surprise even her closest companions. "The tapering loveliness of her hands was almost unbelievable, found in one who did the things she did," wrote husband George Putnam. After a failed takeoff attempt damaged Amelia's first plane, flight instructor Neta Snook turned to see the young pilot, compact in hand, calmly powdering her nose.



ATCHISON HISTORICAL SOCIETY (TOP); PURDUE UNIVERSITY SPECIAL COLLECTIONS


DESIGNED BY
Amelia Earhart





FLYING AS HIGH *as their tree swing will carry them, two girls play beside the Northern Ireland field where Earhart concluded her solo Atlantic crossing in 1932.*

The day after her battered Vega landed in his father's Ballyarnet pasture, Bert Gallagher joined a crowd cheering its intrepid pilot (right). Today Gallagher (above) treasures a photo of the plane. He named his horse Miss Amelia.



KEYSTONE VIEW COMPANY



a farmer's pasture in Northern Ireland had been easy. Just how harrowing a journey she endured is perhaps most evident from her personal log. It had been kept among the private papers of George Putnam and was subsequently passed to Putnam's granddaughter, Sally Putnam Chapman, who published it last year.

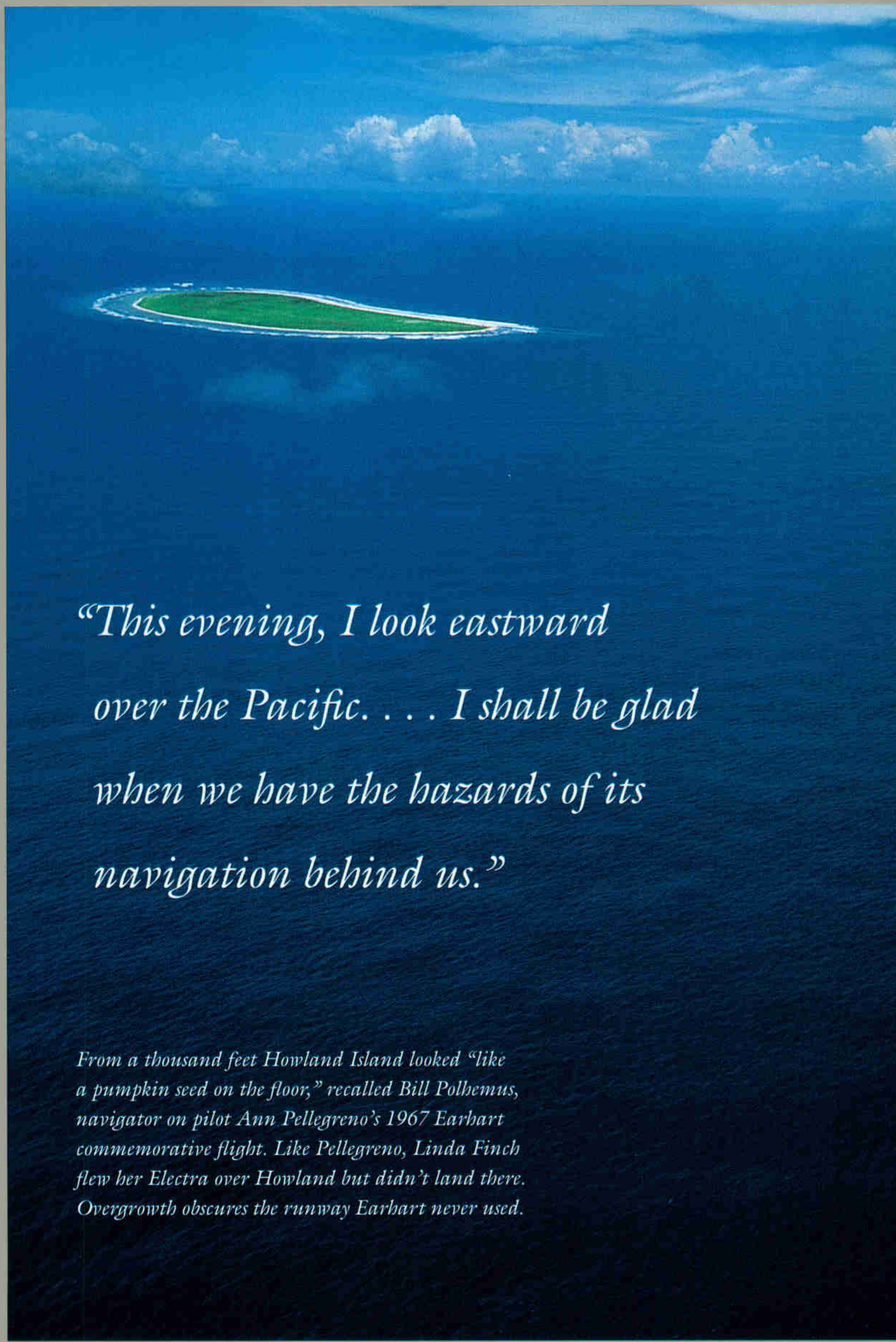
The log covers only five pages of a two-by-three-inch 1932 date book. Earhart's writing, scribbled in pencil, worms raggedly across the page, suggesting that she wrote it while balancing the booklet on her knee. Here are her key legible entries:

"Left 7:15 . . . Over fog 7:40 and rain . . . 7:57 8500 feet . . . icebergs . . . 9:05 fish boat. . . altimeter out." Then a storm closed in. She wrote nothing more until morning.

"8:00 am. 13 hours on the way. If anyone finds the wreck know that the non success was caused by my getting lost in a storm for an hour and then the exhaust manifold, resoldered at St. John, burned out and I have crawled near the water for hours dreading fire."

Translated, the log tells a grueling tale. For the first time in her years of flying, Earhart's altimeter stopped working, so that in the dark she could only guess at her altitude. She flew through fog, then a storm that caused ice to form in her tachometer, sending its needle spinning. With her equipment failing and the storm bringing visibility to zero, she was no longer certain if she was on or off course—or how far she had flown.

Then the plane's exhaust manifold cracked,



"This evening, I look eastward over the Pacific. . . . I shall be glad when we have the hazards of its navigation behind us."

From a thousand feet Howland Island looked "like a pumpkin seed on the floor," recalled Bill Polhemus, navigator on pilot Ann Pellegreno's 1967 Earhart commemorative flight. Like Pellegreno, Linda Finch flew her Electra over Howland but didn't land there. Overgrowth obscures the runway Earhart never used.



shooting flames into the night; with all that fuel on board, it seemed likely the plane would burst into fire. In the next instant a drowning death seemed more certain: The Vega's wings iced up, sending Earhart into a spin. She pulled out of it but by then was so close to the water that she could see the waves breaking below.

"That was a bad moment," Amelia later told a reporter. "A crack in the sea wouldn't be very pleasant, would it?" She flew on in a seesaw course, climbing high enough to use her instruments, then descending toward the sea when the ice grew thick on her windshield. After dawn she flipped the reserve fuel-tank switch and discovered that the cabin fuel gauge was leaking. Gasoline began dripping down her neck. She had no idea how much fuel remained.

When she spotted a ship and then a fishing fleet, she decided to land as soon as she could. A green field presented the handiest spot, and Earhart brought the injured Vega down smoothly. "Where am I?" she asked an astonished Dan McCallion, out herding cows. "In Gallagher's pasture," he answered, and then asked a question of his own. "Have you come far?"

"From America."

"Holy Mother of God," said McCallion, unsure about what was most shocking—that there was a plane in Gallagher's field or a woman dressed in pants.

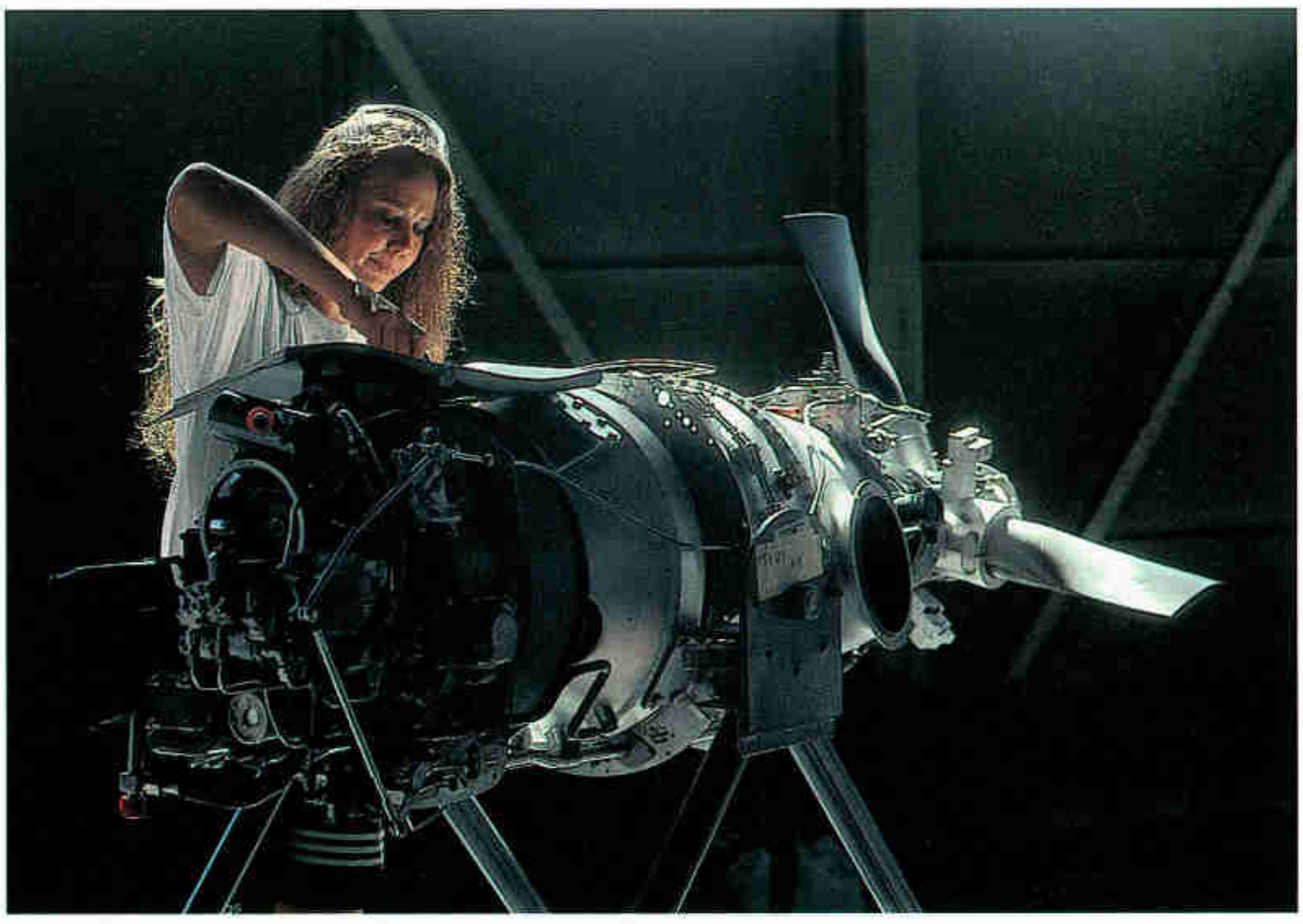
Why had she done it? reporters asked. "I just wanted to see if I could fly the Atlantic alone," she answered. "That was all."

Later Earhart elaborated about her self-imposed challenge: "My particular inner desire to fly the Atlantic alone was nothing new with me. I had flown Atlantics before. Everyone has his own Atlantics to fly. Whatever you want very much to do, against the opposition of tradition, neighborhood opinion, and so-called 'common sense'—that is an Atlantic. . . .

"I flew the Atlantic because I wanted to. . . . To want in one's heart to do a thing, for its own sake; to enjoy doing it; to concentrate all one's energies upon it—that is not only the surest guarantee of success. It is also being true to oneself."

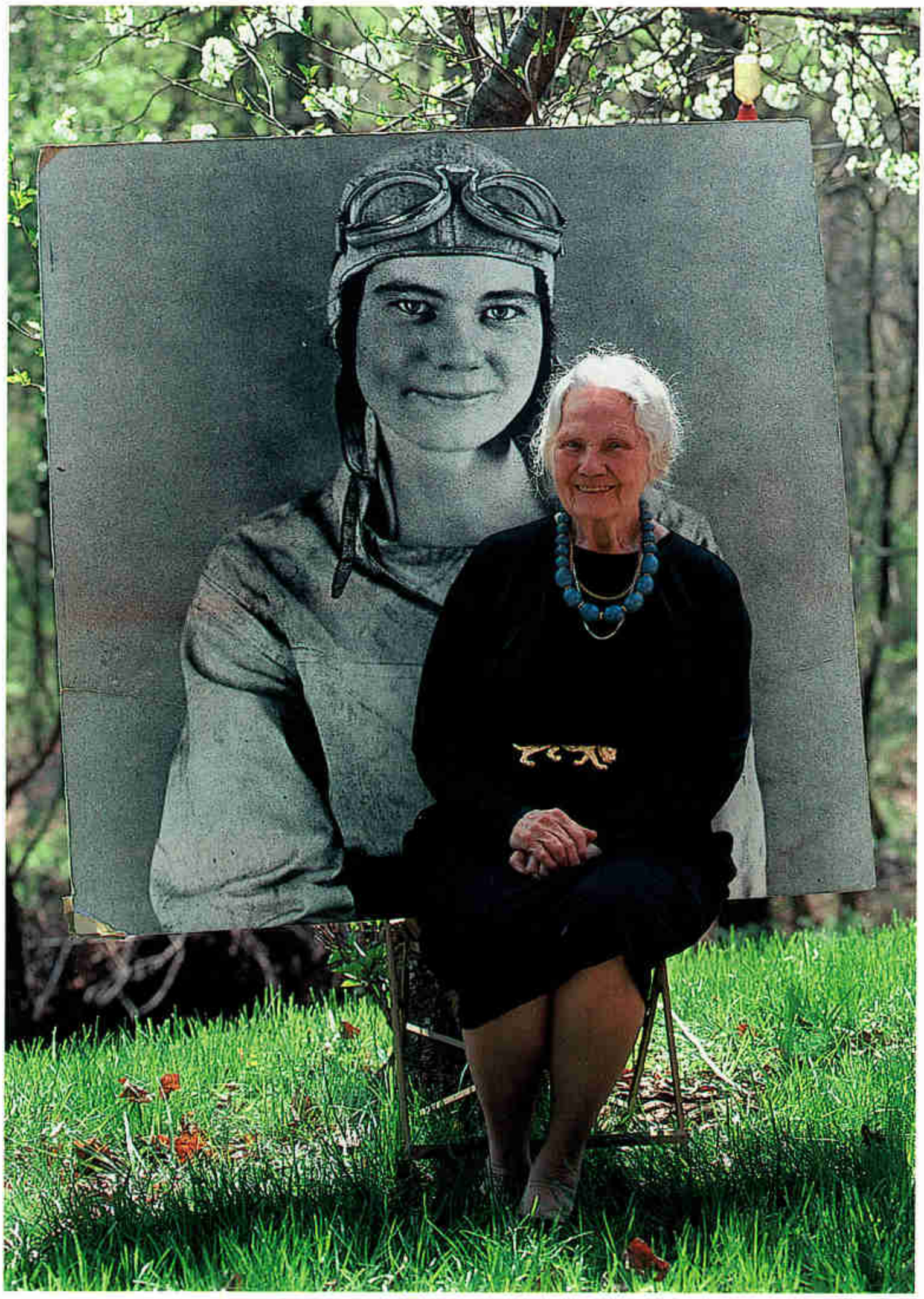
Earhart was feted again in Europe and America for her bravery. In England she dined with George V and, because she never drank, toasted him with buttermilk. New York showered her with another ticker-tape parade, and in Washington, D.C., the House of Representatives and Senate awarded her the Distinguished Flying Cross, making her the first woman to receive it.

This time there were no doubts—even in Amelia's mind—about her accomplishment, although she still responded with the same self-mocking humor she'd displayed after her first crossing. "Some features of the flight I fear have been exaggerated," she told an audience at



A VEHEMENT EARHART *declared that in aviation "it is ability, not sex, which counts." After the first women's cross-country air race in 1929, Fay Gillis Wells (right), Amelia, and other aviators formed an advocacy organization for female pilots. Earhart was its first president. Stacie Lowery (above) would make them proud. She works full-time and maintains top grades in aviation technology at Indiana's Purdue University, where Earhart served as a career counselor.*

Constitution Hall, where President Herbert Hoover presented her with the National Geographic Society's Special Gold Medal. "It made a much better story to say I landed with but one gallon of gasoline left. As a matter of fact, I had more than a hundred. The exact quantity I remember because I had to pay a tax for every gallon imported into Ireland! . . . I did not kill a cow in landing—unless one died of fright." What she hoped for most was that her "small exploit has drawn attention to the fact that women are flying too."



In case anyone missed that point, Earhart continued to set and break records. She became the first woman to fly solo across the U.S., then made the fastest nonstop U.S. crossing. And she became the first person—man or woman—to fly from Hawaii to California.

By 1937 Earhart was the best known woman pilot in America, if not the world. But even this was not enough. "She was a record setter," says Fay Gillis Wells, and couldn't give up wanting to go further, farther, faster. Besides, there was one record she hadn't attempted: becoming the first woman to fly around the world. A U.S. Army Air Service team had already circled the globe in 1924, and Wiley Post had done it twice, once with a navigator in 1931 and once solo in 1933.

Post had used his Lockheed Vega, the same plane Earhart was flying, in all his exploits. Amelia, however, needed something bigger—and with a second engine—because she'd be making the trip at earth's widest expanse, which no one had ever done. Also, she'd promised herself while over the Gulf of Mexico that she'd not cross any more oceans in a single-engine plane; rather, she'd do her over-ocean flying in a plane capable of staying aloft if one engine failed—"just in case," she wrote.

Through the efforts of Purdue University, which hired her as a career counselor in 1935, Earhart received the airplane of her dreams: a twin-engine Lockheed Model 10E Electra, a sleek, full-metal plane that shimmered in the sun.

"That airplane was so innovative—it was as if the designers tore up everything they'd ever drawn before and started from scratch," says Fred W. Patterson III, a historic-plane collector who owns an Electra (and sold a second one to Linda Finch to restore for her Earhart Trail flight). Designed to carry ten passengers, the Electra had plenty of extra space, and Earhart

A SCARF OF TALL GRASS *rippling in the breeze animates a portrait of Amelia Earhart created by "crop artist" Stan Herd. Atchison, home to 11,000 Kansans, unveiled the earthwork on July 24, 1997, to commemorate the hundredth anniversary of its famous daughter's birth. Women pilots who have followed the Earhart Trail joined an estimated 50,000 other celebrators at the four-day party.*

had the engineers modify hers, adding fuel tanks to the wings and fuselage. This raised the plane's fuel capacity from 250 to 1,150 gallons and gave it a theoretical range of 4,000 miles.

INITIALLY EARHART planned to fly west from California around the world. She'd take navigators with her as far as Australia, then continue the trip solo. "For once, if all goes well, it will be the males, in a manner of speaking, who do the walking home," she wrote just before embarking on the first leg of her flight—California to Hawaii. That flight went smoothly enough, but all did not go well leaving Hawaii. Earhart ground-looped the plane on takeoff. With 900 gallons of fuel on board, she'd started down the runway and was racing along when the Electra swerved violently. The right wheel blew and the strut gave way, ripping off the landing gear. The plane spun more than 180 degrees and slid backward down the runway, spewing fuel. Earhart and her two navigators were unscathed.

Two months later, her Electra rebuilt, she was back in California, ready for a second try. Climatic conditions had changed in the interim, and this time Earhart headed east. She'd dropped her plans for a solo flight too. Fred Noonan, a highly regarded navigator, would guide her from his seat at a table in the rear of the Electra, where he could spread out his celestial navigation books. To communicate in the noisy plane (the soundproof insulation had been removed to reduce weight), Noonan and Earhart used a bamboo fishing pole to pass notes back and forth.

Their route led from Oakland to Miami, south to Brazil, then across the Atlantic to Africa. They left Natal, Brazil, at 3:15 a.m., after scouting the grassy runway with their flashlights, and put the Electra's wheels down 13 hours and 12 minutes later in Saint-Louis, Senegal. Five years after her harrowing solo crossing, Earhart noted that her latest flight was just another "uneventful" trip over a sea that "has been flown so many, many times." But it hadn't been that easy: Gas fumes in the cockpit left her nauseated, and rainstorms and head winds buffeted the Electra most of the way. Still, she was a quarter of the way around the world.

From Senegal Earhart pointed her plane due east, flying north of the Equator across central Africa and over "stretches of country barren beyond words, a no-man's-land of eternal want." In Eritrea, after a particularly long day, Earhart suddenly realized that as usual she had eaten nothing. By now pilot and navigator had a set pattern: up before 4 a.m., in the air before dawn, on the ground by early afternoon. After seeing local officials and tending to the plane, they were lucky to get five hours of sleep a night. The most important thing, Earhart wrote, "was seeing that our faithful sky steed was well groomed and fed. . . . So the geography of our journey likely will remain most clearly memorized in terms of landing-field environments; of odors of baking metal, gasoline and perspiring ground crews; of the roaring of warming motors and the clatter of metal-working tools." Of the other sights around her, "the delectable perfumes of flowers, spices and fragrant countryside; the sounds and songs and music of diverse peoples . . . we clutched what we could."

Every day brought a new landscape: India, Siam, Malaya, Australia. On June 29, nearly six weeks after setting out, Earhart and Noonan reached Lae, New Guinea. Their next destination was the tiny U.S. territory of Howland Island—a speck of earth some 18 flying hours away. Beyond it was Hawaii and home. "Fred Noonan and I are sitting here looking out across 7,000 miles of Pacific Ocean," Earhart wrote in her last dispatch. "It is the last ditch I must hop before I can get back to tell George, my husband, 'There you are, I've done it.'"

Earhart and Noonan, of course, never made it back. They disappeared somewhere over that



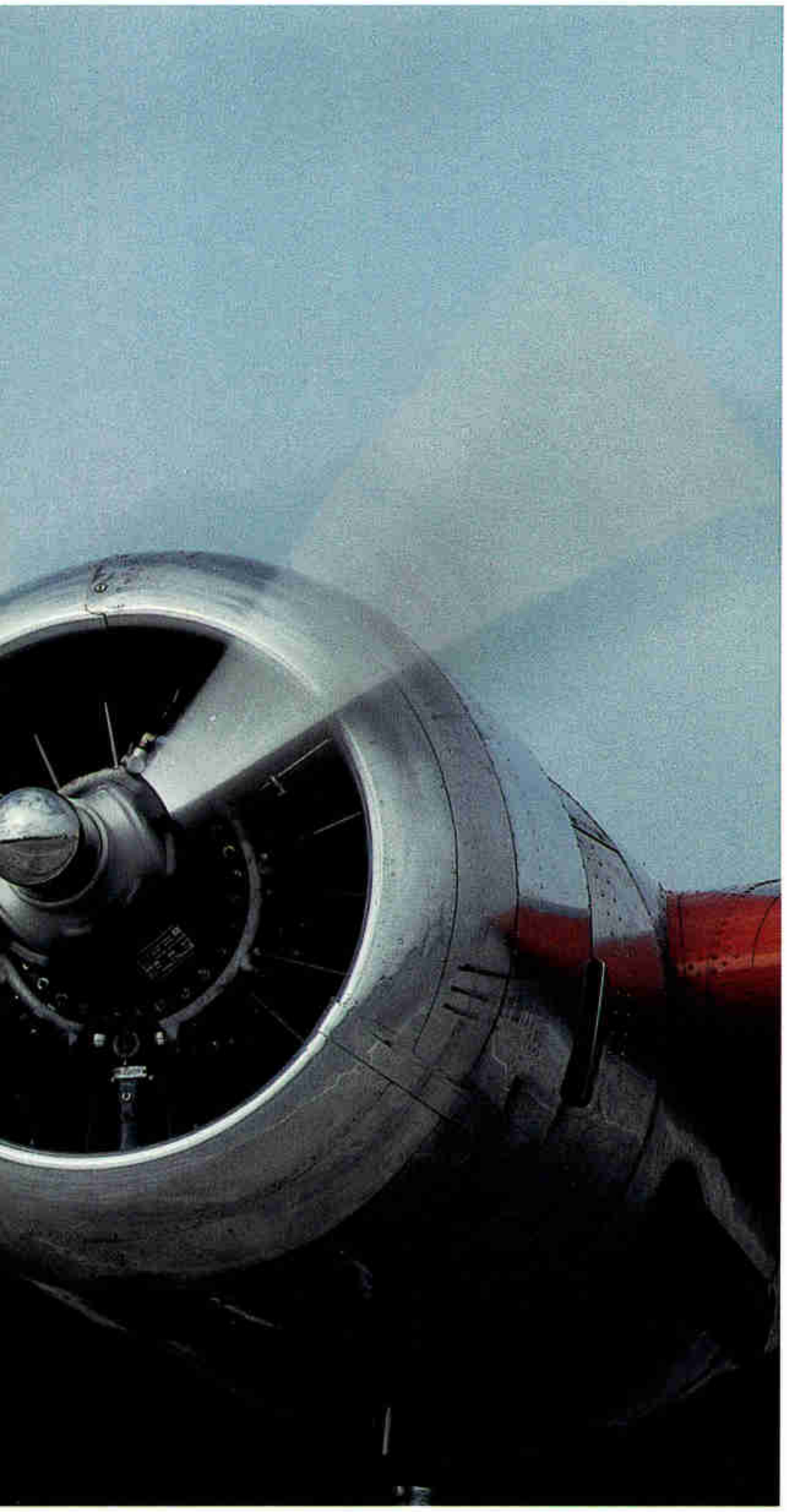


blue ditch, apparently close to Howland. Her final radio transmission—describing their search for the island—was received by the U.S. Coast Guard cutter *Itasca*, standing off Howland Island, at 8:44 a.m. on July 2 (across the International Date Line). "We are on the line of position 157-337. Will repeat this message. . . . We are running north and south." And that was it; nothing was heard from Earhart again.

Despite a massive search by sea and air—and despite George Putnam's efforts to track down every lead, including those provided by a pilot friend known for her psychic visions—no trace of the Electra was ever found. A year and a half later Putnam had Amelia Earhart declared officially dead.

BUT THERE WAS something about Amelia that people would not let die. Newspaper editors sensed it at the time of her disappearance. "Amelia Earhart . . . 'had something,'" noted one editorial. And it was that something, opined another, that would lead to an "Earhart legend. . . . Indeed, its seeds have already begun to sprout. She has already been seen (according to rumor) in an isolated part of Japan. . . ."

Over the years more such "sightings" have been reported, leading to numerous investigations and books about what Earhart was really doing in the Pacific. The basic story line in all these studies hinges on the belief that Earhart,



far from just trying to set another record, was actually on a spying mission for the U.S. government. They suggest that she was either forced down or captured in her floating Electra and taken to a Japanese-occupied island. Then, depending on the teller, Earhart was killed or carried away to Japan, where Emperor Hirohito made her his mistress. In increasingly preposterous versions of the latter saga she's then used as a bargaining chip in the settlement of World War II and brought back to the States, where, after plastic surgery, she lived under an assumed identity and ended her days selling Tupperware in New Jersey.

Other Earhart researchers say it is more in keeping with Amelia's straightforward

WAVING *to well-wishers, Linda Finch brought her vintage Electra back to Oakland, California, as World Flight 97 reached its successful conclusion last May 28. Earhart's travels ended abruptly somewhere in the Pacific, but wherever an adventurer offers a brisk salute or flashes a jaunty grin, Amelia's bold spirit endures.*

character to believe what she said about her last flight. "You either believe her, or you don't," says Elgen Long, who with his wife, Marie, has spent 25 years investigating Earhart's disappearance. "And if you do, then her last words indicate that she was doing exactly what a lost pilot should have been doing: flying a search pattern, looking for that island." Noonan missed it, say Long and others, because the navigational charts at the time showed it in the wrong location. "I'm sure Noonan got them near where the island was supposed to have been, according to their charts. That's why Earhart said [in a radio transmission to the *Itasca* at 7:42 a.m.], 'We must be on you but cannot see you.'"

Long points out that Earhart also said that she was running low on fuel. "She probably had a little more than an hour of fuel left at that point." And when that ran out, Earhart sent her last message, giving their position as best she could. Long suspects that they ditched in 17,000 feet of water somewhere in a 2,000-square-mile area west of Howland Island. "When I go," Earhart often told her husband, "I'd like best to go in my plane. Quickly." If Long's theory is right, Earhart may have been granted her wish.

"The love of flying," Earhart once said, "is the love of beauty. It was more beautiful up there than anything I had known." For 16 years she drank in that beauty, touching down on earth just long enough to share with the rest of the world what she saw and learned on her flights. The public loved her for that—and for her smile, her courage, and her grace. "It is so good to think she was known and loved over so much of the world and deserved it," her mother once wrote to a friend, after Amelia disappeared, "for she was straight and simple." □

Join our online forum on Amelia Earhart at www.nationalgeographic.com.

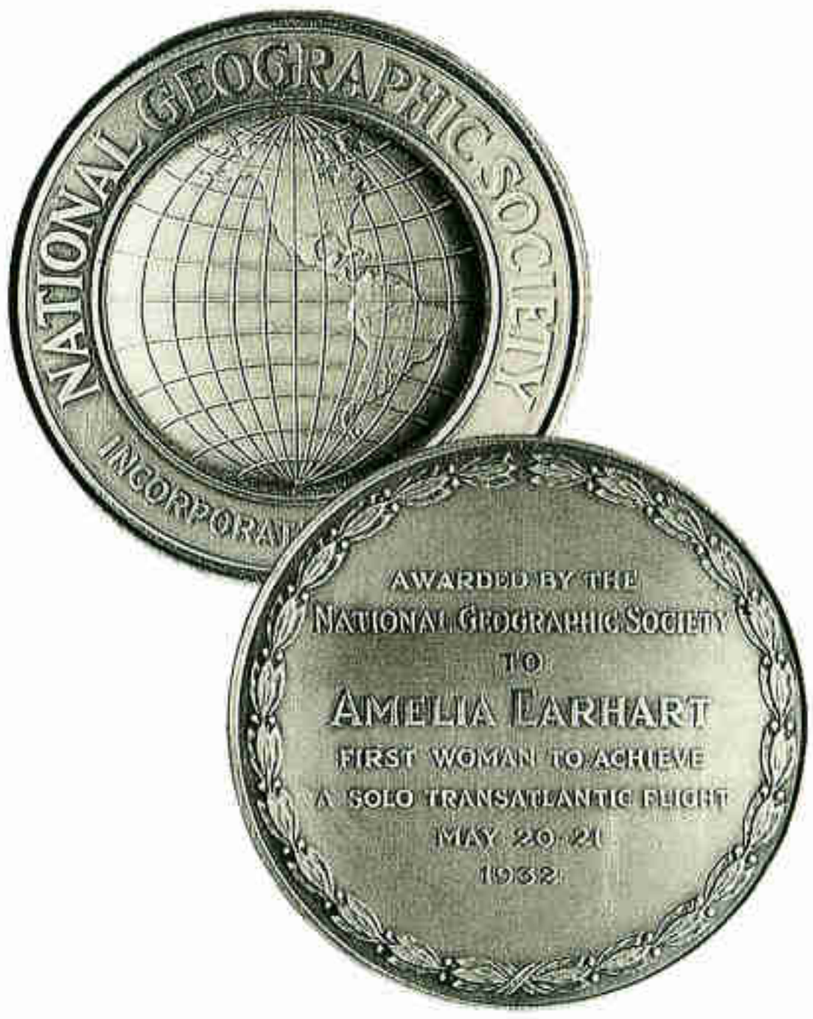


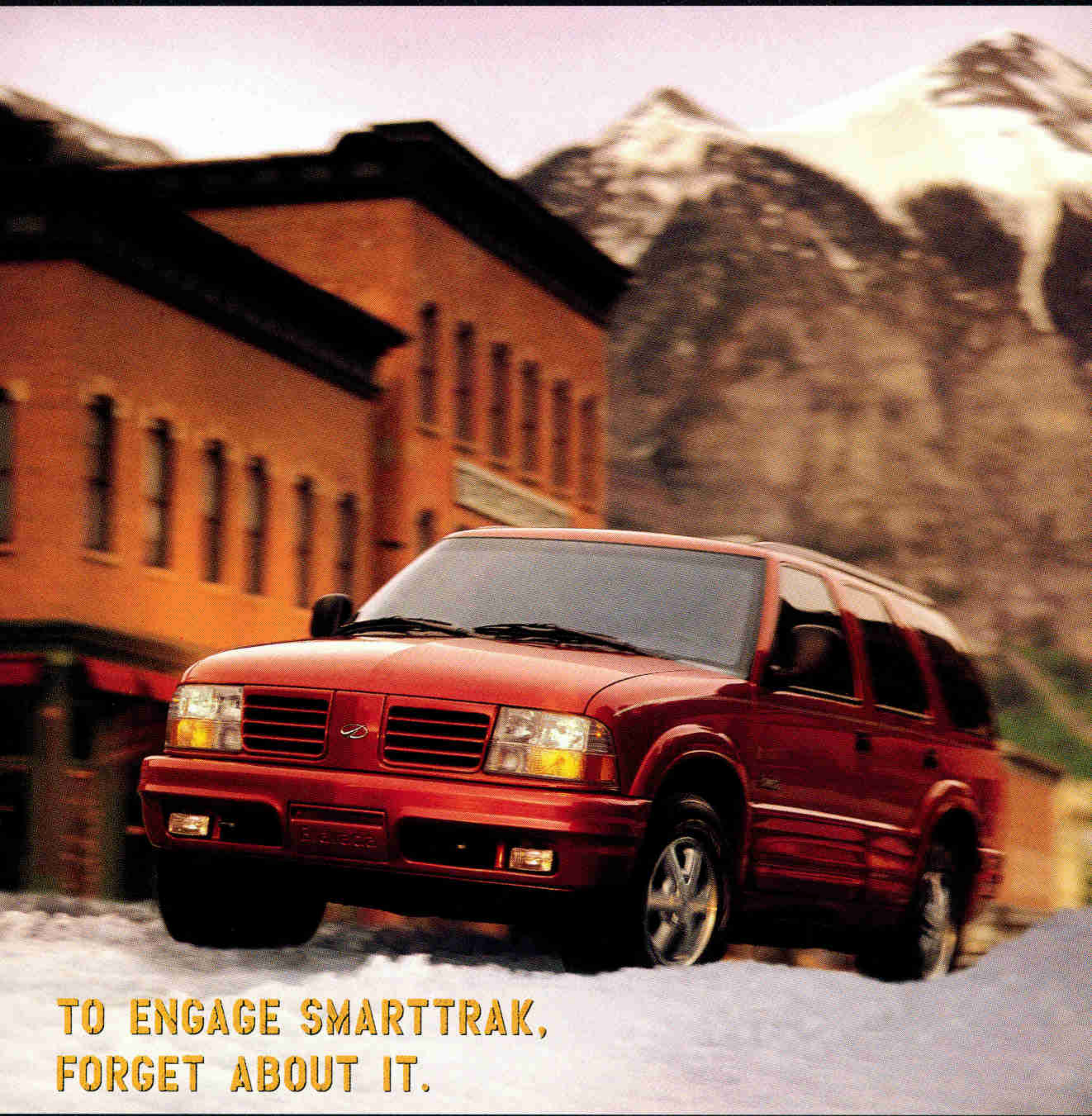
ACME NEWSPICTURES

■ FROM THE GEOGRAPHIC ARCHIVES

Another Golden Moment for Amelia

"As my altimeter was out of commission, I could not tell whether I was 50 feet off the water or 150. I only knew I was too close," recalled Amelia Earhart as she received the National Geographic Society's Special Gold Medal (right) for her solo transatlantic flight in 1932. President and Mrs. Herbert Hoover, flanking Earhart, presented the medal; Society President and Editor Gilbert H. Grosvenor, in white, Earhart's husband, George Palmer Putnam, center, and Associate Editor John Oliver La Gorce also joined in the honors. "I . . . concluded that I must fly under the altitude, whatever it was, where I collected ice. . . . When daylight came I could see on my wings traces of the ice which had gathered," she said. "Probably, if I had been able to see what was happening on the outside during the night, I would have had heart failure then and there; but, as I could not see, I carried on."





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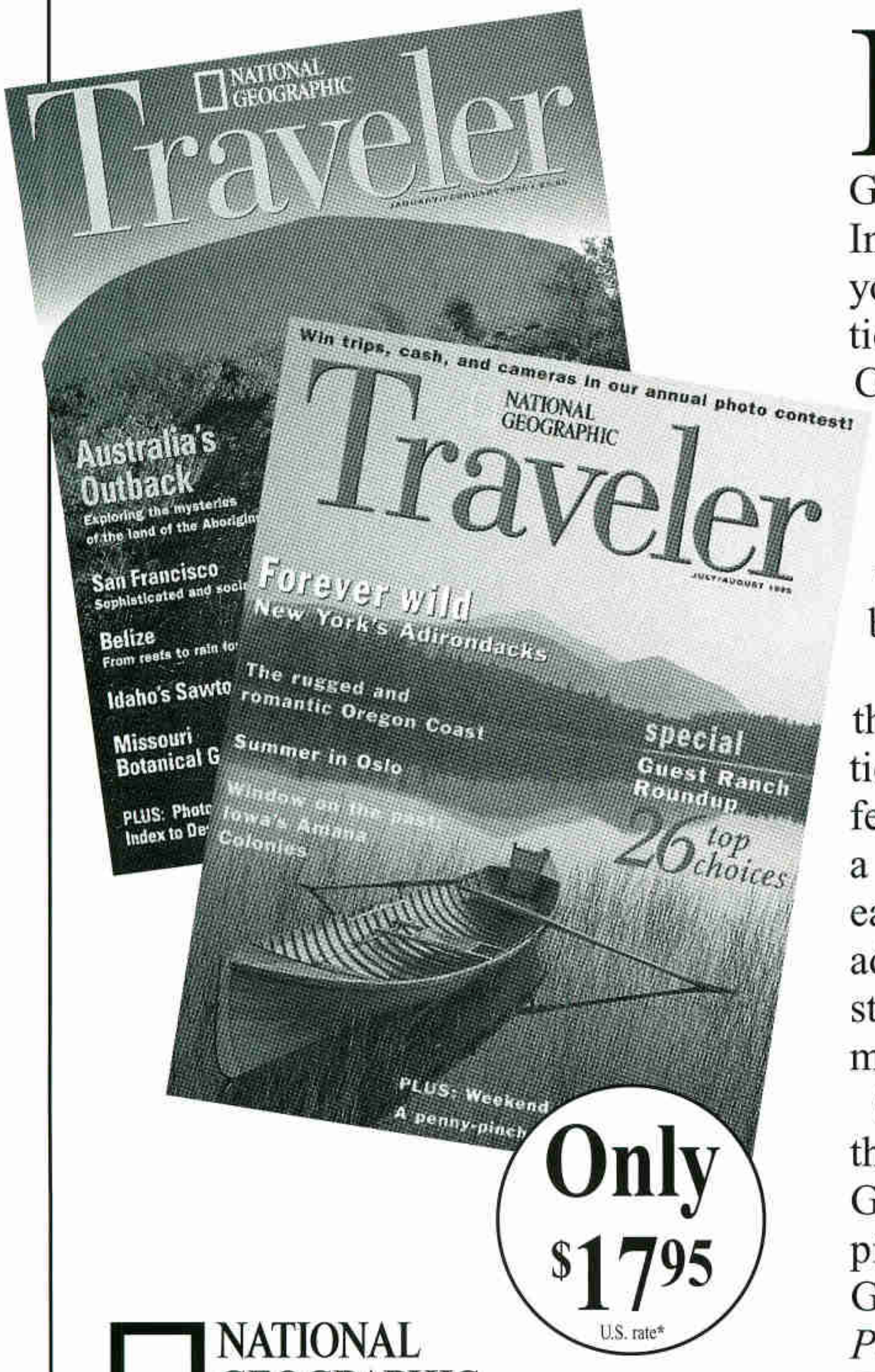
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NATIONAL GEOGRAPHIC

On Television



DAVID LIITTSCHWAGER AND SUSAN MIDDLETON

■ SPECIAL, JAN. 24, 8 P.M. ET

Portraits of Survival

"Bring us face-to-face with each one of those species, make us know that they are our companions in the biosphere," says the renowned biologist Edward O. Wilson to photographers David Liittschwager and Susan Middleton in the new National Geographic Special, "America's Endangered Species: Don't Say Goodbye."

The program accompanies the photographers on a quest across America to photograph the animals and plants on the U.S. threatened and endangered species list. From California's High Sierra to the coastal forests of North Carolina, Middleton and Liittschwager crisscrossed the country in a converted milk truck to bring the plight—and individuality—of threatened species into sharp focus.

Every picture tells a story. The black-footed ferret (top left) had nearly become extinct in the wild when the last known 18 animals were quarantined at a breeding facility in 1987. Hundreds of offspring have since been released.

Encounters with rare plants and animals—(left to right, from middle of top row) MacFarlane's four-o'clock; the red wolf; a leaf of the single surviving wild Presidio manzanita, which cannot reproduce on its own; the bald eagle, America's symbol; and the Wyoming toad—also brought encounters with special human beings. Biologist Tom Eisner goes "chemical prospecting," guided by the behavior of insects. Arthur Bonner, a former gang member, nurtures the extremely rare and beautiful Palos Verdes blue butterfly.

"America's Endangered Species" carries the photographers' message of hope—that when we see what we have to lose, we will not allow it to simply fade away.

■ PROGRAM GUIDE

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GERALD KOOYMAN

Antarctic Accidental—an All-white Penguin

"We thought it was a lump of snow," recalls Gerald Kooyman, a biologist at Scripps Institution of Oceanography. He and his son, Carsten, were counting chicks, nearly 20,000 of them, in an emperor penguin colony near Cape Washington in December 1996. But the lump moved—it was a young penguin. Only its brown eyes were a normal color. (True albinos, which cannot produce any pigment, appear to have pink eyes.) With its shimmering coat, how will this penguin fare against predatory leopard seals? "When it's swimming near ice, it may be camouflaged," says Kooyman. "But if a seal sees it from above, with contrasting dark water below it, it's at risk."

Right Whales: A Striking Case for More Help



AMY KNOWLTON, NEW ENGLAND AQUARIUM

Northern right whale populations have yet to recover from four centuries of harpooning. Perhaps 300 exist, swimming from New England waters along the coast to give birth off Georgia and Florida. There they meet oceangoing vessels—too often with results like this wounded fluke. "Since 1970 we have recorded 45 northern right whale deaths, including 16 struck by ships," says Scott Kraus of the New England Aquarium in Boston.

After six whales died in early 1996, protective measures were increased. The National Marine Fisheries Service now directs all vessels and aircraft to stay 500 yards from this species. Fishermen and many lobstermen must modify gear so that lines break if a whale becomes entangled. The Navy, which has long conducted training exercises from its base at Mayport, Florida, has moved some activities farther offshore, and its ships are avoiding the calving grounds as much as possible.

"But we need to figure out how to keep commercial shipping vessels from hitting whales," says Kraus.

Disease Makes Pariahs of Yellowstone's Bison

By 1900 only two dozen American bison remained in Yellowstone National Park. But soon other buffalo were imported, and Yellowstone's herd revived. Now, in some quarters, concern for the animals seems to have died with its boots on. Last winter, an unusually harsh one, nearly half the park's 3,500 buffalo perished; 400 succumbed to natural causes, while 1,100 were felled outside the park in programs run by Idaho and Montana, where state riflemen (top) shot to kill. When buffalo wander into cattle country in these states, they are usually destroyed, but some have made it all the way into the town of Gardiner, Montana (right).

The buffalo's "crime"? Some carry brucellosis, a disease that, if contracted by cattle, can cause abortions. Montana officials staunchly back ranchers who fear brucellosis—although no case of buffalo infecting cattle has been proved. Though buffalo are little affected by the disease, it does cause abortions among some 30,000 elk outside the park. They also carry brucellosis—but are not shot for it.

"We really hate what's going on," says John Varley, Yellowstone's chief of resources. When the buffalo leave Yellowstone, the Park Service's jurisdiction ends. Varley says sporadic culling has gone on for 30 years; the problem now is that roads and mechanically hardened snowmobile trails make it easy for the animals to leave the park. Horseback riders haze the animals with noisemakers to herd them back inside. "But you can only herd a buffalo when it wants to be herded, and in the dark it can't be done," Varley notes.

He hopes that a recent National Academy of Sciences study "will tone down the rhetoric among all the camps." State and federal agencies are preparing an environmental impact statement, which is due next fall.



JIM PEACO, NATIONAL PARK SERVICE



WILLIAM CAMPBELL



BABS AND BERT WELLS, OXFORD SCIENTIFIC FILMS

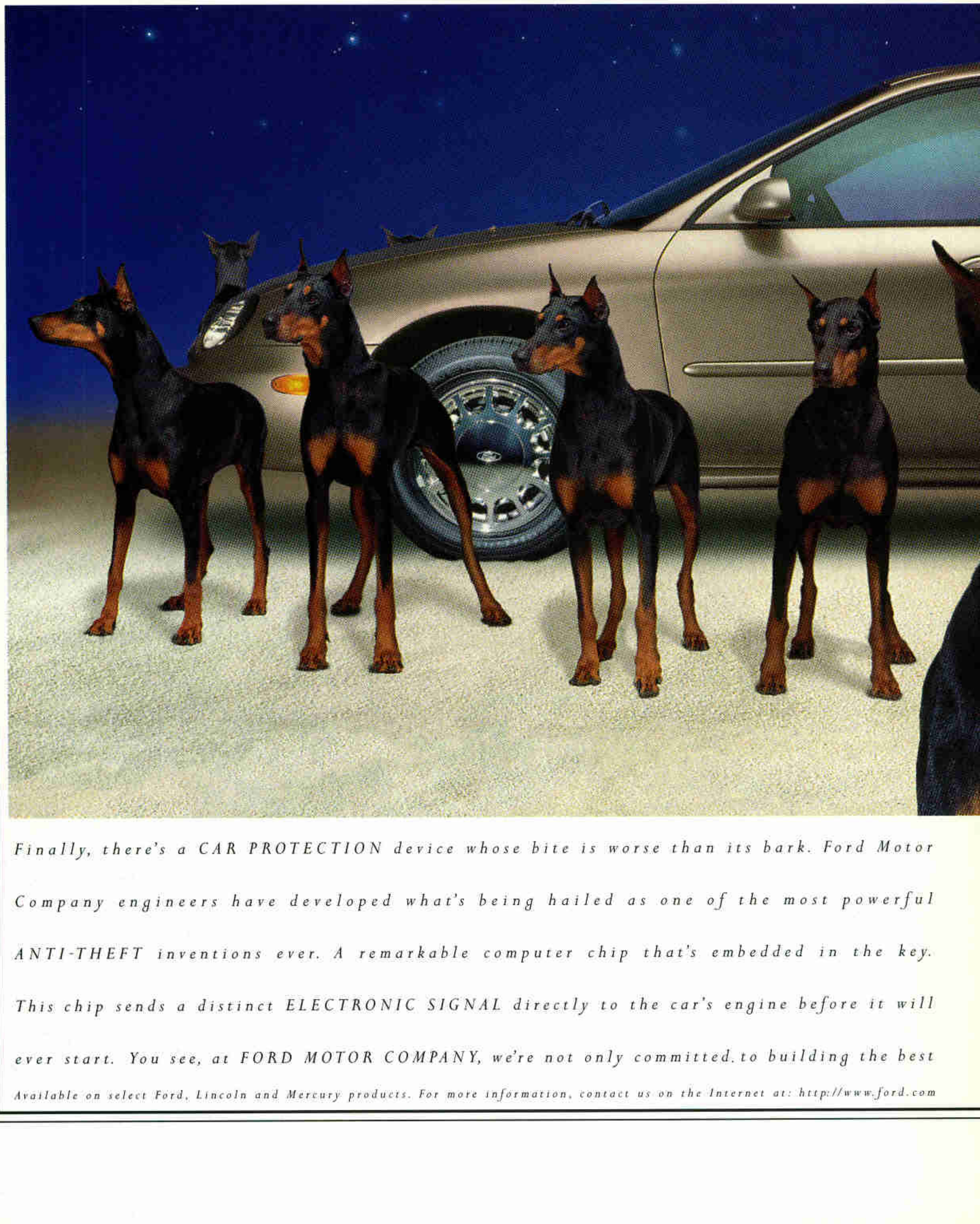
Australian Lizards: True Blue, Mate

Most lizards go through the same old motions of lizard life: Mate, leave your mate, have your young, ignore your young. Not so Australian sleepy lizards, which lead more complex lives and practice monogamy more faithfully than any other lizards, says C. Michael Bull of Flinders University in Adelaide.

More than 80 percent of sleepy lizards stay with their mates for two breeding seasons, and some relationships last ten years or more. And though no other lizards recognize their young after birth, female sleepy lizards can discriminate between their offspring and those of other sleepy lizards. The species may live as long as 30 years—perhaps the reason they have no problem with commitment.

TEXT BY JOHN L. ELIOT

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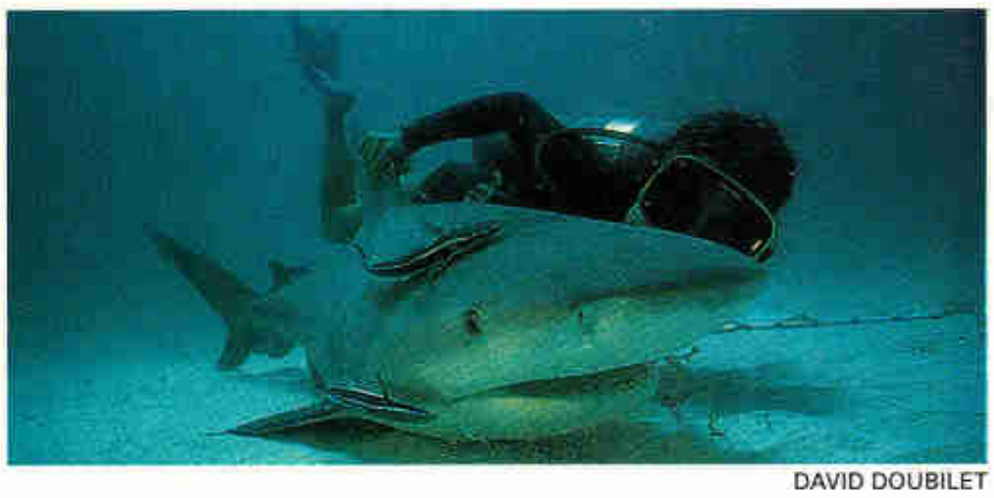
■ ONLINE

Eye to Eye With Recovered Treasures and Reviled Creatures

In recent years our staff archaeologist, George Stuart, an expert on the Maya, has embarked on a quiet crusade to have looted pieces of the Mesoamerican past returned to their countries of origin. Already boxes of artifacts are showing up at his Society office, sent by anonymous collectors. Now you can look at some of the long-lost pieces on our website. This somber Maya monkey countenance (above) once graced a building facade in the great city of Copán in western Honduras. Our digital film gives you a 180-degree perspective of the sculpture seen by few others in more than a thousand years. This work and the several others on our online feature owe their new life to George's deft brokering. Get a glimpse at *www.nationalgeographic.com/features/97/treasures.*

■ Fins surround you in the water—but don't panic. It's Shark Surfari, a kid's-eye view of these ancient fish. The only teeth on these cyber sharks are the quiz questions that challenge your knowledge—and your prejudices. Dive in at . . . */features/97/sharks.*

■ She disappeared in 1937 but fascinates us still. What do you think happened to Amelia Earhart? Read her profile in this issue and respond at . . . */media/ngm/9801/forum.*



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On Assignment

■ AMELIA EARHART

Flight of Fancy

An old hand at flying, photographer Sarah Leen tried out this plywood model for a joke photo in Atchison, Kansas, during a hometown celebration of Amelia Earhart's 100th birthday. "I felt like I'd really gotten to know this woman," says Sarah, who last year followed a re-creation of Earhart's famous last flight. "Seeing the little Electra over Howland Island felt so right," recalls Sarah of her chase-plane view of Earhart's last known whereabouts. "It was where it should have been 60 years ago. It was what Amelia would have wanted."



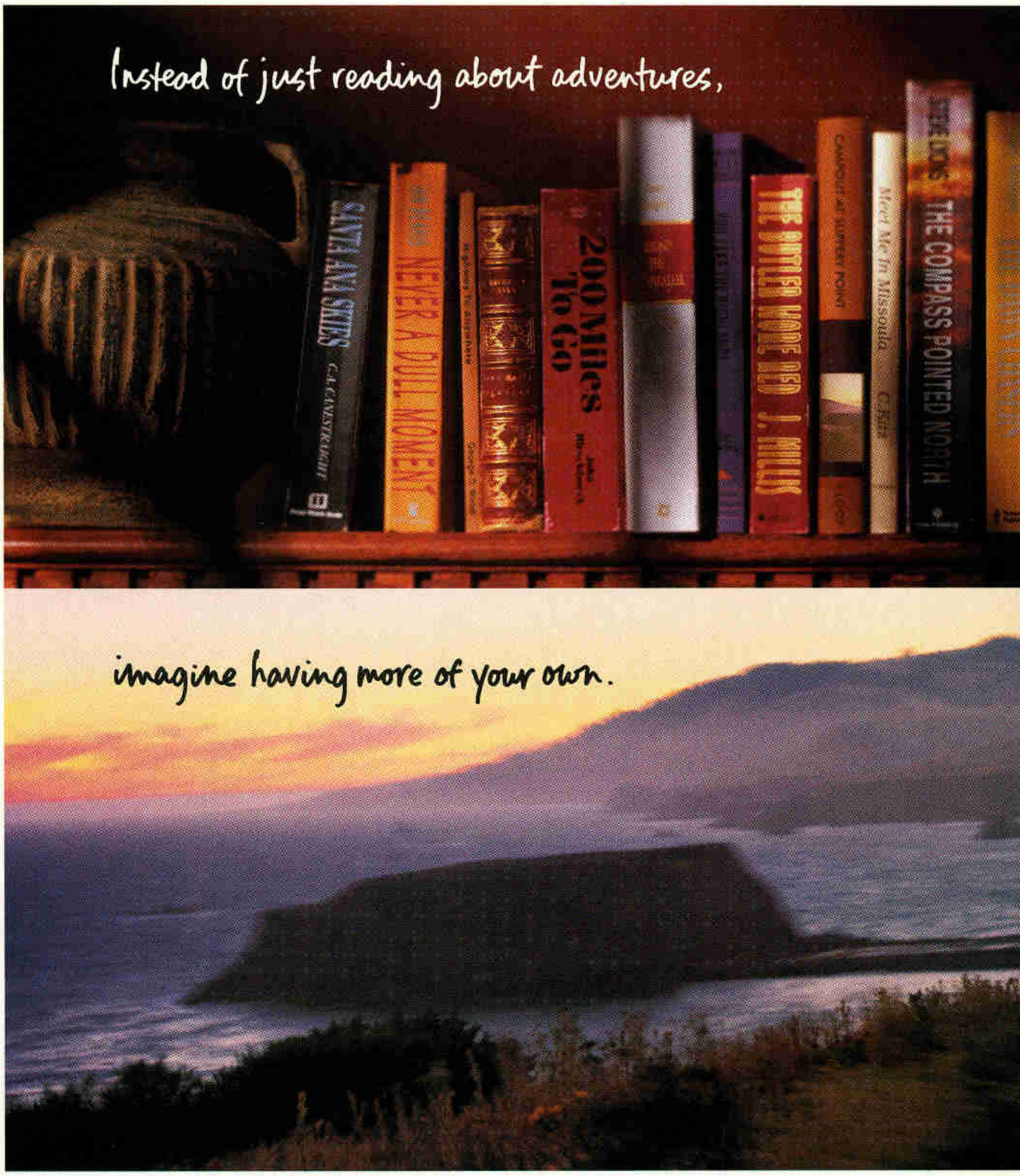
■ MILLENNIUM SENSE

Thinking Ahead

We're ready to take on the year 2000—a little early, thanks to the planning done by our millennium team of (back row from left) David W. Wooddell, Mary McPeak, Katherine Ozment, (front row) Bill Douthitt, Joel Swerdlow, Lisa Lytton-Smith, and photographer George Steinmetz (cut-out). The group, recruited from all areas of the magazine, spent months brainstorming. They researched general topics, picked specific subjects, pondered layouts, and designed a special millennium logo. What's in store? "So much," says committee chairman Douthitt, "it'll take two years to tell you."

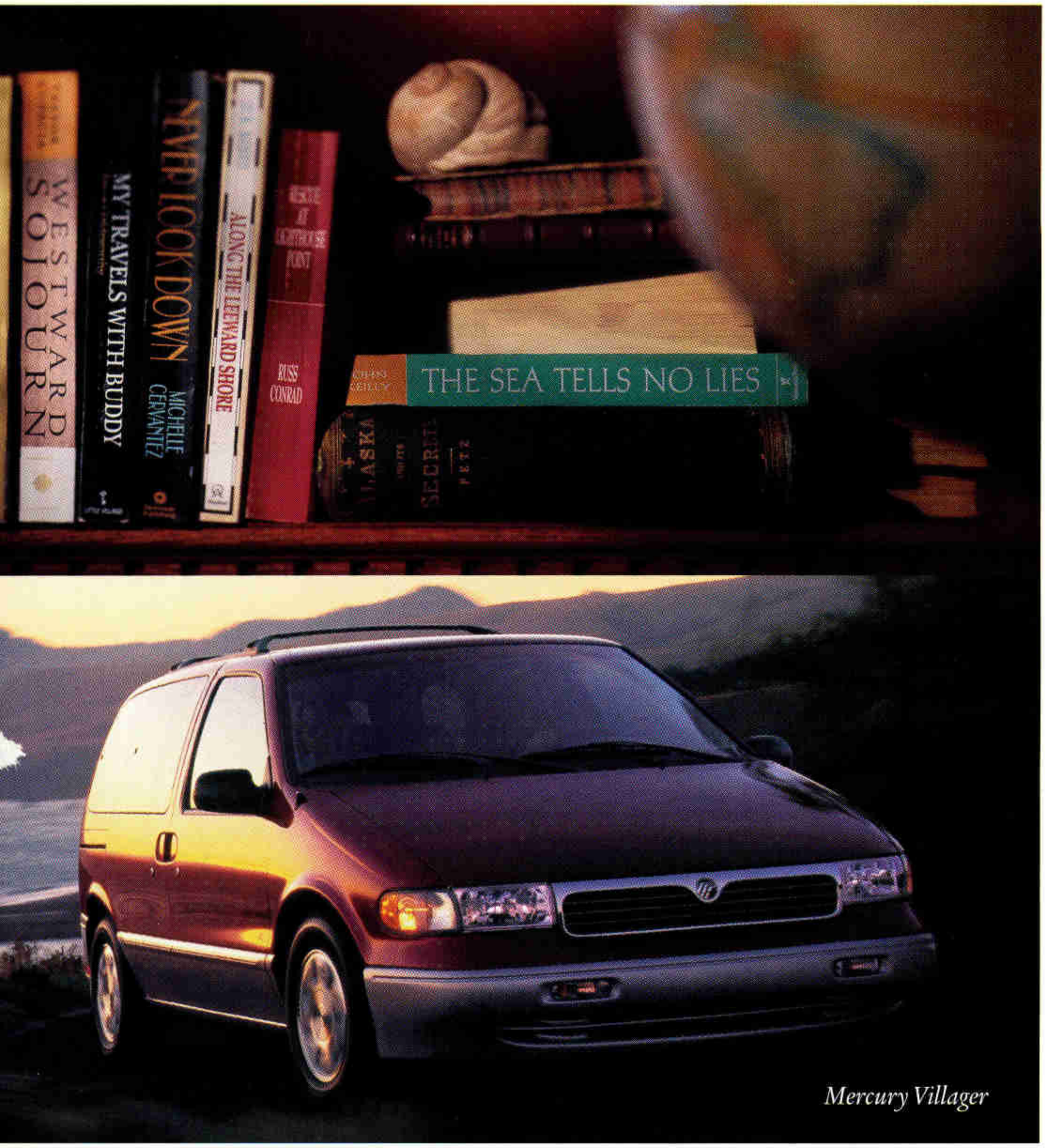
ROX STEC (TOP); MARK THIESSEN, NGS

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